LEVEL II

PLANNING STUDY TO ESTABLISH DOD MANUFACTURING TECHNOLOGY INFORMATION ANALYSIS CENTER

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TEMPO

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SANTA BARBARA, CALIFORNIA
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PLANNING STUDY TO ESTABLISH DOD MANUFACTURING TECHNOLOGY INFORMATION ANALYSIS CENTER

FINAL TECHNICAL REPORT

GE80TMP-43

Submitted to:

Director
Army Materials and Mechanics Research Center
Watertown, Massachusetts

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FOREWORD

This Final Technical Report presents the results of the Planning Study to establish a Department of Defense (DOD) Manufacturing Technology Information Analysis Center (MTIAC) and supersedes the Interim Report, dated August 1980. The study was conducted by General Electric-TEMPO under Contract No. DAAG46-80-C-0026 for the Army Materials and Mechanics Research Center (AMMRC) in Watertown, Massachusetts, over a 7-month period from May 1980 to January 1981. The primary purpose of the study was to explore the concept of an MTIAC and provide DOD with the information needed to decide if an MTIAC should be funded and how it should be implemented. In particular, the intent of the study was to determine the need and desirability for such a center and its possible roles, scope of activities, and key operational considerations.

Primary contributors to the study were: Louis A. Gonzalez, Project Leader; Margaret McMurray; Patricia M. Green; Warren A. Chan; Vijay A. Tipnis, Consultant; and Shirley L. Wakefield, Consultant. These individuals were responsible for the surveys, analytical and design tasks, and final consolidation of the results presented in this report.

The study team acknowledges with grateful appreciation the invaluable assistance of many individuals and organizations in DOD, the Manufacturing Technology Advisory Group (MTAG), the Military Services, federal government agencies, and private industrial firms with interests and concerns in the field of manufacturing technology (MT). Without their help and candid views, the study objectives could not have been met.

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PURPOSE OF STUDY

The purpose of this Planning Study was to determine the need and desirability of establishing a Department of Defense (DOD) Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a center should undertake. The study includes an analysis of the effects of operating an MTIAC at several funding levels and provides an implementation plan to guide its establishment and initial operation.

Other important elements of the study were to: (1) define prospective users of the center and their information needs; (2) assess the potential and requirements for interfacing with existing DOD information analysis centers (IACs) and other private or governmental manufacturing technology (MT) data bases; and (3) identify operational considerations and constraints affecting establishment and future development of an MTIAC.

APPROACH

The approach to performing the study was based upon organizing the data-gathering, analytical, and other activities required for the contract tasks into the following major work areas:

1. Prospective Users Survey and Definition
2. Existing Information Resources Review and Evaluation
3. MTIAC Conceptual Model Definition and Analysis
4. MTIAC Implementation, Startup Strategy, and Future Development.

Each of the work areas was structured to provide a logical sequence of activities that, collectively, resulted in a comprehensive analysis of the need, desirability, and feasibility of establishing a DOD MTIAC. The work areas were planned to provide both the information for subsequent work area activities and the key outputs that are included in this final technical report.

CONTRIBUTORS

GE-TEMPO contributors to this planning study effort were:

Louis A. Gonzalez, Project Leader

Margaret McMurray, Engineering Aide

Patricia M. Green, Research Assistant

Warren A. Chan, IAC Operations Specialist.

Other contributors to the study included:

Vijay A. Tipnis, MT Consultant (President, Tipnis Associates, Inc.)

Kenneth W. Kepner, Aerospace MT Consultant (General Electric-Space Division)

Shirley L. Wakefield, MT Applications Consultant (General Electric-Aircraft Engine Business Group).

KEY FINDINGS

- The clear reaction from the results of the planning study surveys, reviews, and interviews was one of support--in terms of expressed need and desirability--for governmental action leading to the establishment of an MTIAC.
- Many advocates for the need to establish an MTIAC indicated that its primary function should be to encourage the transfer and promote the application of promising MT developments and assure their relevance to the needs of the private sector.
- The information needs of prospective MTIAC users are not satisfied by the existing information system. One of their first urgent needs is to bring together a comprehensive collection of all MT information in one place and under one system of analysis. An MTIAC can serve as such a unifying force.
- There is no component of the existing system concerned exclusively with the complete spectrum of MT. The system is fragmented in terms of MT interests and concerns, resulting in data bases devoted to highly-specialized technical areas.
- No single information facility can acquire all the materials needed by members of the MT user communities. This is primarily due to the subject spread of the MT literature. This indicates

a need for an MTIAC to develop a cooperative system for resource sharing among the various data bases and information centers currently housing significant MT collections.

MAJOR RECOMMENDATIONS

1. Based on the results of the planning study, it is recommended that the DOD sponsor and initiate administrative procedures to establish an MTIAC within 2 years with the mission of improving the diffusion of DOD MT program results by serving as a focal point between defense-related industries and the Military Services.

2. It is also recommended that the MTIAC be:

   a. Operated and staffed by one of several qualified nongovernment, DOD contractor organizations

   b. Administered by DIA and technically monitored by a Military Services agency such as AMMRC

   c. Initially funded (by OSD and the Military Services) at an annual level ranging from $400,000 to $700,000 with a growth not to exceed $1,000,000 in 5 years.

3. It is further recommended that MTIAC implementation and development be:

   a. In accordance with a phased-development approach initially focusing on: developing the MT document collection and data bases, designing publications, and emphasizing diffusion of completed DOD MT project results

   b. Based on a startup strategy with a near-term emphasis of limited technical scope and user access and activities of a priority nature to DOD and its industrial contractors

   c. Based on maintaining a service charge system for the center's products and services that will result in a rate of reimbursement of up to 50 percent of the direct DOD funding within 3 years of establishment.

SECTION 1
INTRODUCTION

PURPOSE OF REPORT

The purpose of this report is to document the work performed relevant to the Planning Study to Establish a DOD Manufacturing Technology Information Analysis Center (MTIAC). The work reported was conducted by General Electric-TEMPO under Contract No. DAAG46-80-C-0026 for the Army Materials and Mechanics Research Center (AMMRC) in Watertown, Massachusetts.

BACKGROUND AND PERSPECTIVE

The capability to produce cost-effective qualitatively superior weapon systems on a timely basis is significantly affected by the availability of advanced manufacturing technology (MT). The Department of Defense MT program was established over 20 years ago with the aim of shortening the industrial innovation cycle by investing DOD funds for first case, factory floor application of more productive MT. By sharing and reducing the technical and financial risks, the MT program encourages the private sector to undertake follow-on implementation of successful MT projects. It also assists in diffusing new technology throughout the U.S. industrial base, thereby expanding its capability and competitive posture.

Since its inception, the MT program has embraced hundreds of projects designed to improve methods of producing military systems. MT projects span a broad range of technical processes and disciplines from improvements in welding techniques to advanced production methods. Over the years, many of these MT projects have shown significant cost savings. Others have reduced lead times to test and deployment, improved safety, reduced pollution, or provided alternates for scarce materials. As a minimum, many successful MT projects resulted in a more productive way to manufacture DOD materiel. Prior to the mid-1960s, the DOD MT program had a heavy munitions and armament orientation. Although these areas remain a major element, during the mid-1960s the MT program began to develop a broader technology base including electronics-oriented projects.

Major emphasis was placed on the DOD MT program in April 1975, when Deputy Secretary of Defense Clements issued a "Cost Reduction Initiatives" memo to the Service Secretaries. The memo requested the Secretaries to centralize the management of their MT programs, to increase program funding, and to create new initiatives to realize reduced manufacturing costs of weapon systems. This memo created a nationwide interest in improving MT. It also increased private industry's interest and participation in DOD's Manufacturing Technology Advisory Group (MTAG).

MTAG was initiated under DOD Instruction 4200.15 to provide Tri-Service MT program coordination and consists of seven groups and six technical subcommittees. The policy group, the Executive Committee, is chaired by members of the staff of the Office of the Secretary of Defense. Other members are from the Service Headquarters staffs and the MT offices. The chairmen and members of each technical subcommittee are DOD technical experts in their respective fields. They review MT project proposals and identify areas of common interest, duplication of effort, and technology voids.

The urgent need for improvement in manufacturing productivity has also been recognized and highlighted in non-DOD areas. For example, in the summary of a General Accounting Office (GAO) report (No. LCD-75-436) released to Congress in June 1976, the Comptroller General stated:

> GAO now believes that in order to remain internationally competitive and to maintain a strong industrial base, actions must be initiated to make manufacturing productivity a national priority.

A more recent awareness was demonstrated in October 1978 when President Carter signed an Executive Order establishing a National Productivity Council to serve as a focal point in the Executive Branch to improve productivity in the private and public sectors of the economy. One of the Council's assigned responsibilities is technology innovation including improved production methods and management systems.

Because of the sound goals of the program and the constant budgetary pressures to reduce defense materiel costs, the DOD has placed increasing emphasis on the MT program in recent years. For example, the importance of the DOD MT program was reemphasized by Dr. William Perry, Under Secretary of Defense for Research and Engineering, in a February 1, 1979 statement to Congress wherein he identified MT as a major DOD technology thrust area. The use of technology to reduce manufacturing costs of DOD materiel procurements was one of Dr. Perry's fiscal management initiatives to reverse the trend of increasing materiel acquisition costs, of which production is considered 75 percent of the total. The MT program is a key element in this initiative.

A major problem area within the DOD MT program that is increasingly recognized in government and industry is the implementation and diffusion of project results. Resolution of this problem is not only necessary to ensure the long-term viability of the MT program, but would also provide potentially large returns on the taxpayers' investment by lowering the cost of defense materiel and improving the productivity and flexibility of the defense industrial base.

In 1979, Dr. Ruth Davis, former Deputy Under Secretary of Defense for Research and Engineering, articulated the need for a more formal means of fostering the rapid diffusion of technology resulting from the MT program. The satisfaction of this need was expressed as a DOD Manufacturing Technology Information Analysis Center (MTIAC). Under the aegis of the Defense Logistics Agency (DLA), the Army Materials and Mechanics Research Center (AMMRC) was requested to assess the feasibility of establishing such an MTIAC. The determination of the need, desirability, and scope of activities for an MTIAC is the concern of AMMRC Contract DAAG46-80-C-0026 awarded to General Electric-TEMPO in April 1980 and to which this report is directed.

PROBLEM DEFINITION

Although there are several underlying reasons for the less than desired levels of implementation and diffusion of MT program results, a primary reason is the lack of a single appropriate organization dedicated to this function on a DOD-wide basis. Several uncoordinated government and private initiatives address one phase or another of MT development and diffusion. However, no meaningful organizational, institutional structure or other vehicle in the private or public sectors in the United States emphasizes the assessment and diffusion of current domestic and foreign MT developments or directly assists in the use of such developments to improve U.S. productivity and competitiveness. This study examines the notion that an information analysis center dedicated to transfer and utilization of MT may serve these purposes.

In the history of the development of information centers, this study effort offered a unique opportunity to review and analyze the total system that underlies a specific mission of national significance. However, any program to establish an IAC of the type envisioned for MT requires an awareness of the many problems attendant to management of scientific and technical information in any area of technology. On a national scale, the significant investment in research and development relevant to the area of MT demands a reasonable coordination of effort to service the information needs of the MT user community, a systematic handling of project results, and an aggressive program to inform industry and other government agencies of successful projects so as to foster wider application of technological advances. The IAC has proven to be one of the most effective

means to satisfy such demands in many other advanced technology areas.

The prime purpose of this study was to provide DOD with the information needed to decide if an MTIAC should be funded and how such a center should be implemented. The study explored the concept of a DOD MTIAC, in particular, the need and desirability for such a center and its possible roles, scope of activities, and key operational considerations.

STUDY SCOPE AND OBJECTIVES

The scope of the study was defined by organizing the data gathering, analytical, and other activities associated with the tasks specified in the AMMRC contract into the following major work areas:

1. Prospective Users Survey
2. Existing Systems Review and Evaluation
3. MTIAC Model Definition and Analysis
4. MTIAC Implementation Plan and Startup Strategy.

Each of the work areas was structured to provide a logical sequence of activities that, collectively, resulted in a comprehensive analysis of the need and scope of activities for a DOD MTIAC. The work areas were planned so that they provided both information for subsequent work area activities and the key outputs of the study.

The approach to the study was concerned with fulfilling the following objectives:

1. Define the rationale for establishing an MTIAC in terms of its need and desirability
2. Identify the potential sources of information inputs and their forms and types
3. Define the prospective users of an MTIAC and their information needs
4. Identify and prioritize the functions of an MTIAC in terms of its product and service offerings
5. Determine the initial technical scope of an MTIAC and its activities commensurate with its proposed funding levels
6. Evaluate the existing MT information resources and define the interfaces with existing DLA-funded IACs and other government and private data bases

7. Plan the implementation of the MTIAC including estimates for staff, services, facilities, and other operational requirements
8. Identify limitations and constraints associated with establishment and operation of the MTIAC, such as dissemination control requirements, and alert its sponsors to critical operational considerations affecting policy and administrative matters
9. Develop tenable short- and long-term goals for phased development of the MTIAC with consideration of the oversight role of MTAG
10. Document the planning study results in a Final Technical Report.

ORGANIZATION OF THE REPORT

The report is divided into an Executive Summary and eight sections. The Executive Summary, which precedes this Introduction (Section 1), outlines the purpose of the study and presents some key findings and recommendations. Section 2 comprises the major findings, conclusions, and recommendations of the study. Section 3 discusses the technical approach to the study tasks. The results of the existing system review and evaluation are presented in Section 4.

The conceptual model of an MTIAC is defined in Section 5 in broad qualitative terms. Section 6 outlines the implementation plan to start up and develop an MTIAC. Factors to be considered in establishing and operating an MTIAC are discussed in Section 7. A list of references used as study inputs or background information is provided in Section 8.

Appendices A through E provide supporting material concerning the study approach and results.

SECTION 2
FINDINGS AND RECOMMENDATIONS

FINDINGS AND CONCLUSIONS

The principal findings and conclusions presented below were derived from interviews with key individuals in DOD and military MT program offices, the Manufacturing Technology Advisory Group (MTAG) and its technical subcommittees, industrial firms serving as DOD contractors, directors/administrators of information centers, and officers of professional societies and trade associations. It was only with the assistance and cooperation of these individuals that the necessary information was acquired to conduct the analyses for this planning study.

It became apparent during the early stages of the study that the data collected could be expanded many times, validation processes could be engaged in, and sophisticated techniques of analysis could be applied to a much larger data body. However, the position adopted in this regard is that the optimum effort has been made for the purposes to which the findings are to be used, considering the evolving nature of the prospective user community and the instabilities of the political and economic environments in which the broad field of manufacturing technology is developing.

MTIAC Need and Desirability

- Although there were a few isolated exceptions and some ambiguous responses, the clear reaction from the results of the surveys, reviews, and interviews was one of support--in terms of expressed need and desirability--for governmental action leading to the establishment of an MTIAC.
- Recent studies by the federal government, defense agencies, and some industrial firms implied that the diffusion of new MT developments would be enhanced by the establishment of some sort of national center which could serve as a clearinghouse, a catalyst, and a coordinator for research, application, and demonstration efforts for promising MT developments.

- Past experience indicates that the DOD has not been entirely successful in bringing about widespread utilization of MT program results in the defense sector of the economy, not to mention penetration of the even larger "market" for non-defense applications of these results. An MTIAC was considered desirable from this standpoint.

- Many advocates for the need to establish an MTIAC noted that there is no central entity which: (1) organizes and analyzes documents emanating from MT programs; (2) assures that the DOD MT research efforts are relevant to the needs of the private sector; (3) fosters the transfer of newly-developed MT into practical use; and (4) performs an advocacy function of assuring that adequate resources are employed to promote the application of promising MT developments.

- In general, prospective users and consultants to the study, both in and outside the government, feel that an MTIAC would be a positive move toward encouraging the technological progress which enables the economy to produce new or improved commodities and services and more of previously produced commodities and services using existing or modernized productive resources.

- Members of MTAG subcommittees and MT program offices of the Military Departments expressed the view that the more the DOD can do to encourage widespread utilization of MT program results, including establishing an MTIAC, the greater will be the impact on the U.S. industrial base and the higher the taxpayers' return on investment.

- There has been a marked improvement in providing DOD MT program documentation to the private sector in the past 3 years. The quality, quantity, and frequency of technology transfer has steadily improved through the distribution of 5-year plans, budget-year project descriptions, ManTech Program bulletins, the ManTech Journal, National Technical Information Services (NTIS) Technical Notes, and end-of-contract briefings and demonstrations. DOD, MTAG, and Military Services advocates for establishing an MTIAC feel that a center could coordinate and improve such efforts with private industry cooperation.

- Potential users expressed the view that an MTIAC could assist the DOD MT program to improve its

documented information distribution system. While an enormous amount of information is distributed each year, improvements can be made to tailor it to the needs of potential users. In addition, potential users often have to inquire from several sources before they get what they need. There is a need to improve the ability to find out rapidly and effectively what has, is, or will be done by the DOD MT program.

- The eventual benefits related to national goals were also expressed by knowledgeable individuals contacted in the study as a rationale for establishing an MTIAC as soon as practical. These benefits included:
  - -- Contributions of new MT to raising living standards
  - -- Greater national security and more effective peace-keeping programs
  - -- Improved quality of living provided by technology that can be used to abate pollution, conserve resources, and improve working conditions related to health and safety
  - -- Reduced rate of inflation as a result of increased productivity
  - -- The assistance new technology provides in obtaining favorable balance of trade.

Alternate Views of MTIAC Need

- Some directors of existing information centers expressed either negative or ambivalent reactions to the need for an MTIAC. These were primarily based on concerns that IACs are proliferating unnecessarily and that "expansion of the technical scope of an existing information center would be more cost-effective than creating a new center."
- The MT program management area with the greatest need for improvement is the procedure for more comprehensively documenting benefits and payback achieved by the total program. This should be expected a priori, for the program output is information--how to manufacture items more productively. Views expressed by some DOD contractors, however, emphasized the difficult, if not impossible, task an MTIAC would have in obtaining much of this information, since it may involve items

of a proprietary nature that many industrial firms would be unwilling to reveal.

- Other negative reactions to an MTIAC were also expressed during the surveys and interviews. For example, it was viewed by some as yet another "costly government bureaucracy with dubious merit." The argument that an MTIAC would exist to serve the needs of the DOD and non-DOD contractor community in advancing MT developments proved unconvincing. Some users are convinced that a central management information system (MIS) on all DOD MT projects is all they need.

Potential MTIAC Users

- The MT user population appears to be large and diffuse. The study identified three distinct groups--the sponsors/funders, MT/R&D producers, and MT users--consisting of eight user communities:

  1) MTAG and Subcommittees

  2) DOD Agencies

  3) Military MT Departments

  4) Other Federal Government Agencies

  5) DOD MT Contractors

  6) Professional/Trade Societies

  7) University/Research Centers

  8) Other Industrial Firms.

- Many potential users are involved in MT activities only some of the time. A majority of users, however, expressed a need for a central source of MT information, most enthusiastically the DOD Contractors community, followed by Other Industrial Firms, MTAG, and Military MT Departments.

- To MTAG subcommittee members, the most helpful role of an MTIAC would be to increase information flow between the Services to avoid wasteful duplication and aid them in evaluating and monitoring DOD projects. In contrast, prospective users in the Other Industrial Firms community appear unconcerned about the type of center established "as long as they can get the information they want, when they want it, and in the form they want it."

- Prospective industry users expressed the view that an MTIAC should be limited to the needs of the government and U.S. companies. They indicated that there are few, if any, techniques the center could use to limit foreign dissemination of MT project results without also severely limiting the access to such information by the desired users. They also were adamant, however, in their view that an MTIAC should not knowingly assist nondomestic organizations in obtaining information. It was desired that an MTIAC have a central role in controlling dissemination of MT results that give U.S. industry a competitive edge over foreign manufacturers.

Information Needs

- Quick responses to technical inquiries, state-of-the-art reviews, and current newsletters were the three services/products given highest priority by MTAG, DOD, and non-DOD industry. The first urgent need, however, is to bring together in one place and under one system of analysis a comprehensive collection of all current MT information.
- Several prospective users in industrial firms have voiced concern about difficulties in obtaining information about specific projects. They feel that this may lead to missed opportunities for MT utilization. To cope with this deficiency, they are now forced to maintain extensive networks of contacts within the Services to keep abreast of relevant developments. They have a strong need to know of the MT information available.
- A directory of industry capability to "help the user find the expert" was also an expressed need. There is no existing guidebook or directory to MT information resources organized by technical interest area and there is a lack of information search skills in the MT communities necessary to locate and use such resources.
- Potential users also expressed a need for the MTIAC to develop and maintain a data base on MT resources with relevant capabilities of DOD agencies, key individuals at each Military Services MT program installation, and nongovernment MT experts.

- MTAG subcommittee users offered the view that the MTIAC should develop and maintain a computerized data base with information on completed, ongoing, and planned MT developments classified, as a minimum, in terms of technical disciplines and functional applications.
- One of the major needs is for better mechanisms for maintaining current awareness of latest MT research papers and reports as they are issued. The time lag between the presentation of a paper or publication of a technical report and the announcement of its availability may be a matter of many months. A similar delay occurs between the time a paper is given at a professional society meeting or conference and the publication of the proceedings of the conference. While industry members regularly attend professional society meetings, it is obviously impossible to cover them all.
- There is a need for a better means of accessing information in existing MT project reports. While there is much valuable information in the reports issued to date, it is cumbersome to sift out needed information.

Existing Information Resources

- The existing MT information system can be divided into five major components:
  - -- DLA-funded IACs
  - -- Professional societies, industry and trade associations, and advisory groups
  - -- Military data bases
  - -- Other federal data bases and information centers
  - -- Commercial data bases.
- There is no means for the existing information system to integrate MT program results to give every type of user within and among user communities an overview of total DOD MT activities. The majority of information activities having some functional relation to MT are concerned with serving the organization housing them.

- The single most pressing need for the system is to pass on the MT program results to those concerned with their application on the "factory floor."
- The primary means of information transfer in the existing system is via the informal investigator-to-investigator route.
- There is no component of the existing system concerned exclusively with the complete spectrum of MT. The system is fragmented in terms of MT interests and concerns resulting in data bases devoted to highly-specialized technical areas.
- No single information facility can acquire all the materials needed by members of the MT user communities. This is primarily due to the subject spread of the MT literature. This indicates a dire need for resource sharing among the various data bases and information centers housing significant MT collections which could eventually lead to a cooperative system.
- Some MT information needs may be satisfied in whole or in part by tapping into one or more of the MT data bases available. Other needs cannot be met by existing data bases, either because the required MT data do not exist and must be compiled (for example, robotics data for a specific application), or they exist but are not available in a formal data base and must be gathered through informal communications.

MT Information Sources

- The most popular MT information sources stated in the user survey were periodicals, seminars/workshops, and government reports. Internal sources within a company, professional societies, and existing information centers were also used, in that order of preference. Communication also exists between each user community, the most effective being informal.
- Other major MT information sources appear to be the Military Services MT program offices, industrial firms with large MT literature collections (such as General Electric, Hughes Aircraft, and Bendix), the DTIC, and NTIS.

- There is some evidence of dissatisfaccion with the present time-consuming labor of finding relevant information on MT generally, and on DOD contracts specifically. Users state, "it is difficult or impossible to keep abreast and be aware of the MT information that is available. Then, often the information must be sifted from a large volume, and sometimes tracked to several different sources before it is complete or reliable."
- The professional societies which appear to be good MT information sources as indicated by the existing system review are the SME, ASM, ASME, and the Welding Research Council. Other societies and trade associations may emerge as the center becomes operational.
- There is a high degree of overlap of several of the major MT information sources, each of which might cover a given technical area only partially. To assure exhaustivity in coverage, the center may have to deal with all of them. This poses a problem of costs in addition to coping with incompatible collections and vocabularies.

Potential MTIAC Interfaces

- The IACs which appear to have the most potential for interface are MDC, MCIC, MPDC, NTIAC, and TEPIAC. CPIA and RAC would appear to have more limited interface potential; PLASTEC appears to have some limited interface potential.
- The professional societies indicated above under "Information Sources" may also have potential for interface with an MTIAC. As the center matures, other sources may surface and the nature of the relationships of these organizations with an MTIAC may be more clearly defined.
- It is anticipated that the military data bases identified in Section 4 will heavily interface with and/or be heavy users of an MTIAC.

MT Literature and Data Base

- That much of the existing literature concerning MT is unsuited to the needs of those concerned with the application of MT program results was a strongly expressed opinion of survey participants. End-of-project demonstrations do help somewhat in this regard.

- The present information base, as it can be deduced from statements of information people in fields related to MT, is in the 35,000 to 50,000 documents range. This preliminary estimate does not include classified, proprietary, or foreign literature.
- Increasing emphasis on MT development by DOD and the federal government will have a marked effect on the quantity of MT literature produced during the next decade.
- The most significant growth in the literature from the MT development community will result from the DOD MT contracting program with industry and the establishment of "productivity centers" in large manufacturing firms.
- There is currently no adequate way to classify the literature of MT without a comprehensive classification scheme; such a scheme could also be of use in cataloging and retrieving MT publications. Users familiar with IAC operations feel that to assure the effectiveness of its MT data base, the MTIAC should undertake the development of an appropriate keyword system or classification and coding scheme early in its formation.
- Some concern has been expressed by prospective industry users that the present literature and other information released on advanced manufacturing developments are largely "success" stories. They are of the opinion that such efforts should continue with government encouragement since MT program successes help in the diffusion process. However, it was suggested that it would be equally beneficial for an MTIAC to document "failures" or negative results obtained in DOD MT programs to avoid the risk of pursuing similar unfruitful directions in the future and avoiding needless investment risks.

MTIAC Implementation Startup and Development

- The mission, or charter, which DOD establishes for the MTIAC will have a major impact on the structure and focus of the center. As a minimum, the purpose of the MTIAC should be to effect higher levels of implementation and diffusion of MT program results by serving as a central source

of information and focal point between defense-related industries and the Services. This mission could be expanded as the center matures to include other users (e.g., nondefense manufacturers) and other sources of technology (e.g., DOD mission-oriented developments related to manufacturing).

- Prospective users with knowledge of IAC operations have stated that to fulfill its broad mission, an MTIAC must provide the competence and capabilities to: (1) identify, collect, process, store, and disseminate relevant MT information; (2) prepare or sponsor the preparation of the necessary products and services to communicate this information to users with interests and concerns in MT; and (3) coordinate and augment existing information activities to improve the transmittal of this information to interested organizations and individuals in the government, military, and the private sector.
- A "phased-development" approach to the implementation strategy may be the most appropriate. By this approach, an MTIAC could initially focus on: developing the data bases, designing publications, and emphasizing diffusion of completed DOD MT project results. Further, the center could limit its in-depth technical expertise to only several technology categories, although the center staff may eventually be conversant in all areas of MT.

RECOMMENDATIONS

1. The results of the planning study suggest that the DOD sponsor and initiate administrative procedures to establish an MTIAC within 2 years with the prime mission of improving the diffusion of DOD MT program results by serving as a focal point between defense-related industries and the Military Services.
2. It is recommended that the MTIAC be:
   a. Established to closely conform to the concept discussed in Section 5
   b. Operated and staffed by one of several qualified nongovernment, DOD contractor organizations

c. Administered by DLA and technically monitored by a Military Services agency such as AMMRC

d. Initially funded (by OSD and the Military Services) at an annual level ranging from $400,000 to $700,000 with a growth not to exceed $1,000,000 in 5 years.

3. It is also recommended that MTIAC implementation and development be:

a. In accordance with a phased-development approach as discussed in Section 6

b. Based on a startup strategy with a near-term emphasis of limited technical scope and user access and priority activities

c. Based on maintaining a service charge system for the center's products and services that will result in a rate of reimbursement of up to 50 percent of the direct DOD funding within 3 years of establishment.

4. It is futher recommended that, for effective operation, the MTIAC be guided by the following:

a. Systems and procedures for handling information with restricted access or dissemination that will become part of its data base, including classified information, proprietary data, and export-controlled critical technology data

b. A methodology to define, limit, and control the scope of technical coverage for the center

c. A comprehensive indexing scheme to classify the MT literature for purposes of cataloging, storage, and retrieval

d. Cooperative agreements to exchange MT documents and data with other information centers and services with similar or overlapping technical interests and concerns

e. A computerized data base designed to provide information on completed, current, and planned MT projects emanating from the overall DOD MT program.

5. Much of the work supported by the DOD MT program is related to areas in other government programs. For this reason, it is recommended that

during the MTIAC's formative period, its management become familiar with the purposes, needs, and possible impacts of such programs as the:

a. Department of Commerce, Office of Productivity, Technology, and Innovation (OPTI), and other MT-related programs

b. Cooperative Generic Technology (COGENT) Program

c. Center for the Utilization of Federal Technology (CUFT)

d. NASA's Industrial Application Centers (IACs).

SECTION 3
TECHNICAL APPROACH

GENERAL APPROACH

Figure 3-1 illustrates the general approach to the study and the relationship of the study tasks, data inputs, and study outputs. To provide a basis for program management, Figure 3-1 also serves as the work breakdown structure and is arranged to provide an overview of the approach to the study.

Initially, as indicated in Figure 3-1, the approach was concerned with data gathering by means of a user survey, a review of existing MT information systems and data bases, and a review of existing information centers funded by DLA. Data from the survey and reviews were used to perform a comparative evaluation of "that which exists" and "that which is needed" to derive needs of the potential users and the requirements of the system to serve those needs. The identified needs combined with selective data from the user survey and existing system/centers reviews were then used to define the inputs and outputs of the conceptual model of the idealized MTIAC.

The conceptual model was then analyzed to: (1) provide substantive evidence of the need for an MTIAC, and (2) define and evaluate alternative system (center) configurations from which a recommended center concept could be structured. Procedures for initial startup of the MTIAC and an implementation plan tailored to its orderly phases of growth were then prepared. As a final step, all outputs of the study were summarized for presentation in this final report.

PROSPECTIVE USERS SURVEY

The user survey task of the MTIAC planning study was basically concerned with the determination of the user population to be served by the center and the information needs of these potential users. Specifically, the survey attempted to identify the variables associated with the user population parameter and determine the value or content of each variable and its relationship to other variables in the system. The following user population variables were of principal importance in the survey:

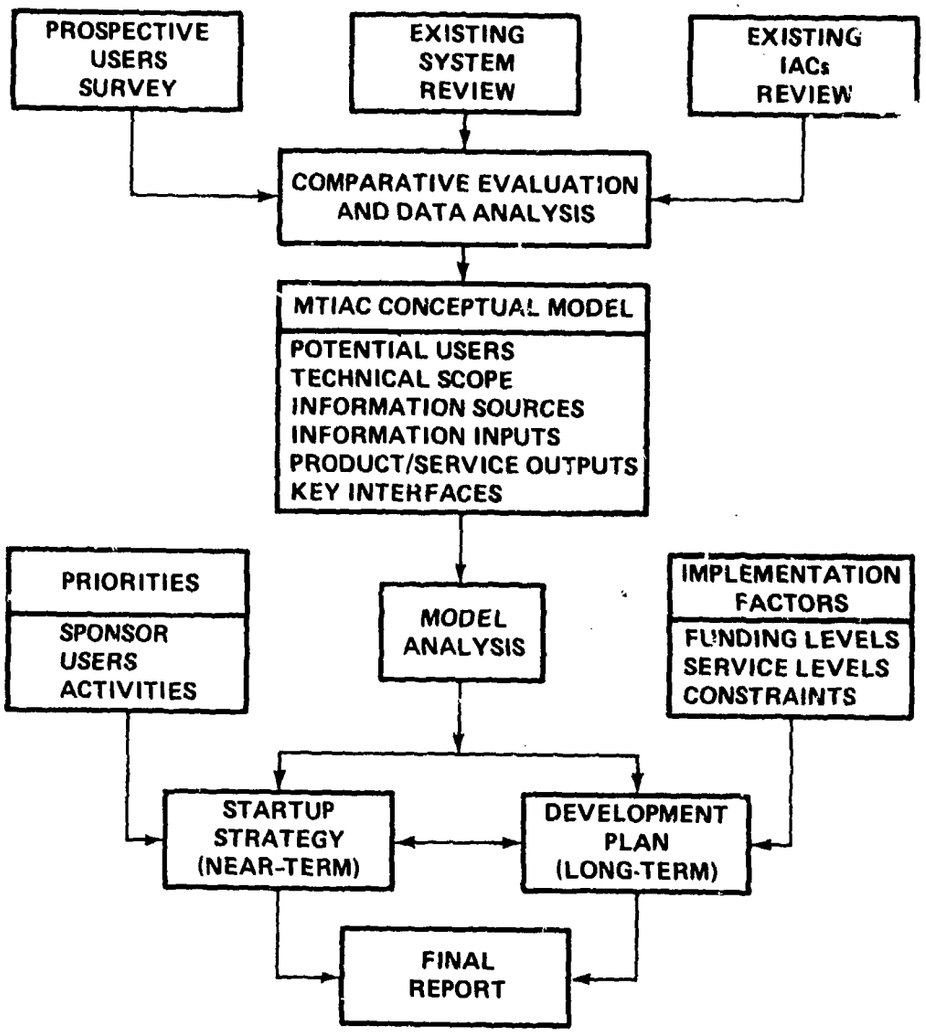

Figure 3-1. Study approach and work breakdown structure.

- Number of distinctive user communities comprising the potential MTIAC user population
- Size and geographical distribution of the potential MTIAC user community
- Discipline, interest, and application of MT for each user community
- Value of each user as a source of information for the MTIAC including type and relative volume of inputs

- Nature of information inputs, viz., classified/unclassified, proprietary/nonproprietary
- Anticipated purposes for which the MTIAC could be used by each user community
- General and special needs of prospective users in terms of information products and services.

Survey Method

Appendix A outlines the requirements for the user survey conducted for the study. Similar surveys conducted prior to the current program were reviewed to avoid duplication of effort. The categories of prospective user organizations contacted include:

- MTAG and its committee and subcommittee members
- DOD agencies with MT concerns
- Military departments (i.e., Army, Air Force, Navy MT Program Offices)
- Other federal agencies with MT concerns (e.g., NASA, National Bureau of Standards, Department of Commerce)
- DOD MT program industrial contractors
- Professional societies with MT concerns
- Universities with manufacturing engineering disciplines
- Other selected industrial sector organizations.

Survey Interviews

The required interviews were conducted on a person-to-person basis or by telephone. Since the interviews were semistructured, each interviewee was free to follow up a particularly interesting line of questioning with original questions of his own, guided by the requirements outlined in Appendix A.

Because of the time constraints placed upon the completion of the user survey task, the most feasible approach was to depend to the greatest extent upon direct contact with a sampling of key organizations and individuals with interests and concerns in MT. Mailing lists available from professional societies such as SME and ADPA indicated not only the private-sector, broadly based MT community, but also the community of DOD MT contractors and educational organizations. Survey information was also solicited by telephone interviews when practical. However, for significant potential users, the survey was conducted by direct contact to the extent possible within budget limitations.

Survey Questionnaire

A copy of the questionnaire and sample transmittal letters prepared for the user survey are also contained in Appendix A. The questionnaire was submitted to AMMRC for technical review and approval before mailing to survey participants. The questionnaire was designed to elicit the information outlined in the survey plan included in Appendix A in addition to the following:

- Potential users' assessment of need for an MTIAC
- Use of existing DOD IACs for MT-related information
- Degree of interaction with technical societies
- Potential user's current MT information sources
- Description of additional MT information requirements (i.e., products/services)
- Interest in foreign MT developments.

The questionnaire was distributed with the appropriate transmittal letter to approximately 500 key individuals from the "Corporate Key Personnel" mailing list of the American Defense Preparedness Association (ADPA). This list was selected since the organizations identified in the list were considered to be fairly representative of U.S. industrial firms with MT interests that may be potential users of an MTIAC.

Other inputs used to develop the questionnaire distribution were:

- MTAG Executive and Technical Subcommittee rosters
- Attendance lists from the most recent Tri-Service Annual MT Conferences sponsored by MTAG
- Active MT industry contractor lists from Air Force, Army, and Navy Project Offices
- A sampling of SME and other professional society and trade association mailing lists.

Survey Response

A rough picture of the prospective users and their requirements emerged from the enumerative aspect of the survey. The data collected could have been expanded many times, but the questionnaire was designed to be short and convenient to complete in order to encourage a high percentage of response. The final response was 54 percent; i.e., of the 700 questionnaires making up the total survey, 380 were completed and returned.

It should be noted, however, that multiple-choice questions are quick and easy to answer although self-limiting. Therefore,

opportunity was given for the users to elaborate, and much qualified information was gained from their comments and from the followup interviews. Appendix D contains examples of quotes representative of frequently encountered and significant comments of prospective user respondents. Considering the evolving nature of the user community and the instabilities of the political and economic environment in which the broad field of MT is developing, this effort was considered optimum without a large expenditure of time and survey funds.

EXISTING SYSTEMS REVIEW AND EVALUATION

Systems Review

Concurrent with the user survey, a review was conducted of the existing systems and data bases with which potential MTIAC users normally interface when seeking MT information. In addition to those of professional societies and commercial data bases, information resources reviewed included significant information facilities which are professionally staffed and can be identified as technical libraries, information, data and documentation centers, or information services that have some concern with the dissemination of MT information. Sample inquiry letters used to solicit data from these information resources are contained in Appendix B.

A number of government, professional, and private data bases were also reviewed since it was felt that they should be fully exploited to develop a current data base on the state of the art in MT. Efficient utilization of these resources would enable the MTIAC to examine significant portions of the world's MT technical information, with minimum investment cost. Further, an important consideration was the immediate availability of this information, avoiding the costly time delay required to construct totally new files of similar information. For example, the review addressed special data banks in the Defense Technical Information Center (DTIC) and the National Technical Information Service (NTIS) which are useful to develop MT program planning data for MTAG and other inputs. These data bases include:

- DTIC Data Bank for DD Form 1643
- DTIC Work Unit Data Bank for DD Form 1498
- DTIC DOD Reports File for DD Form 1473
- NTIS Data Bank
- NTIS Tech Briefs and DARCOM Tech Notes.

Existing System Interfaces

The primary objective of this task was to become familiar with existing information analysis centers (IACs) funded by the Defense

Logistics Agency (DLA) in order to assess the potential for interfacing with these existing data bases so as to preclude creating duplicate resources. Consideration was also given in this task to existing professional society information resources, military service data bases, other federal data bases, and commercial data bases and information services, and their impact on an MTIAC.

DLA-FUNDED IACs. Although some of the DLA-funded IACs are more likely than others to interface with MTIAC, it was determined that all nine of them should be contacted in order not to prejudge their potential for interface. The Directory of Federally Supported Information Analysis Centers (1979) was reviewed and it was determined that two other DOD centers, not DLA-funded, should also be contacted. Data were also solicited from one Department of Commerce data center. These centers are identified in Table C-1, Appendix C.

In all cases, a phone call was made to each director (or his representative) of the center under consideration for review. The data analyst making the contact explained briefly the objective of the overall study and in particular the purpose of the interface analysis task. The purpose of the phone call was to: (1) request certain literature needed by the study team for its analysis (e.g., annual reports, user brochures, newsletters, etc.), and (2) to establish a personal contact at the center to whom a letter could be sent that addressed some of the key questions regarding the establishment of an MTIAC. An example of the inquiry letter used to solicit information from IAC directors is included in Appendix B.

Directors of four of the centers were visited personally, and further telephone discussions with some directors supplemented these interviews and written responses to the inquiry letter.

PROFESSIONAL SOCIETY DATA BASES. A list of professional society contacts was drawn up using the DOD Manufacturing Technology Program Points of Contact and MTAG Technical Subcommittee Membership (October 1979 and May 1980) and the Encyclopedia of Associations (1978) as primary sources. The term "professional society" as used for this group also included industry and trade associations and advisory organizations (such as the Advisory Group on Electron Devices). Table C-2, Appendix C, lists the organizations contacted for review. An initial phone call was made to each contact to: (1) explain the nature of the study and the objective of the specific task, and (2) request permission to solicit information from the contact on behalf of his organization by means of a followup letter. An example of the inquiry letters sent to professional societies is included in Appendix B.

MILITARY SERVICE DATA BASES. A list of existing military service data bases was drawn up based on review of the Defense Documentation

Center Referral Data Bank Directory (June 1978). The list of these data bases is contained in Table C-3, Appendix C.

OTHER EXISTING SYSTEM INTERFACES. Several commercial MT data bases and information services were identified through referrals and the Encyclopedia of Information Systems and Services (1978) and were contacted by phone or letter. Some effort was also directed in the study to an evaluation of the MT information available from commercial data bases and other sources that also constitute the "existing system." For example, the study considered remote terminal dial-up access to commercial on-line systems such as Lockheed's DIALOG and System Development Corporation's (SDC's) ORBIT which may be easily accomplished. DIALOG, for example, covers a wide range of subject areas in science, technology, and engineering and includes U.S. and foreign data bases.

Existing Systems Evaluation

The outputs of the existing systems review were organized to provide meaningful data for determining the strengths and deficiencies of the systems and for consideration in assessing the need for the MTIAC and defining its interfaces. In particular, data were collected, analyzed, and reassembled into outputs pertinent to the following existing system features:

- System characteristics (such as information inputs, system processes, services, products, and communication factors)
- Operation procedures (concerning acquisition, data base management, distribution to users, etc.)
- Equipment and methods (degree of mechanization of operations, methods used to input, file and retrieve data, etc.)
- Interfaces with other MT data systems
- Constraints (budgetary and organizational).

MTIAC MODEL DEFINITION AND ANALYSIS

Model Development Approach

Planning and executing a program to establish an IAC of broad scope presents problems of considerable complexity and detail. A careful and effective approach to designing a center such as the MTIAC cannot be limited to consideration of only a few problems. All the design parameters and requirements of the IAC must be analyzed and given their proper weight in its final configuration. A convenient methodology for conducting such an analysis is to construct an idealized MTIAC input/output model.

A number of alternative approaches to establishing an MTIAC are possible. These approaches differ in various parameters, but primarily in terms of: funding source and levels, breadth of technical coverage, product and service offerings, primary users and information sources, and startup strategies. The MTIAC model can be constructed as an ideal (unlimited resources) input/output model that can serve as a tool to develop alternative MTIAC concepts for subsequent evaluation. Results of the evaluation can, in turn, be used to determine the most promising concept and the most appropriate activities for the center.

The model developed for purposes of this study was based upon the approach depicted in Figure 3-2. This approach divided the analytical task of the model into two sections: descriptive and cost. The first of these is representational; the second is evaluative. The application of the first section results in a graphic description of the MTIAC as a complete system functioning in an ideal environment. The application of the second section results in an economic evaluation of the system described.

The model development approach illustrated in Figure 3-2 identifies and describes, in outline form, the inputs to and outputs from the MTIAC model. The result of the descriptive analysis was a model which represents an ideal system for the dissemination of information to the MT user communities. An important benefit of the cost analysis section was that it will permit the evaluation of operating costs of alternative MTIAC concepts corresponding to alternative funding levels.

Conceptual Framework for MTIAC Model

The conceptual framework for the MTIAC model is shown in Figure 3-3. This framework was devised to structure the model in terms of the set of major planning elements required to develop alternative concepts of the center that could be scaled upward or downward commensurate with alternative funding levels and other variables. Thus, the framework served as the basic tool for identifying and relating the planning elements (solid boxes in Figure 3-3) and the influencing factors (dashed boxes) to be considered in developing the MTIAC model.

As shown in Figure 3-3, the planning elements correspond to data "inputs" and "outputs" of the idealized model. The set of planning elements corresponding to the major "inputs" to the model are:

- The characteristics of the body of MT literature, existing information resources, and bibliographic data bases

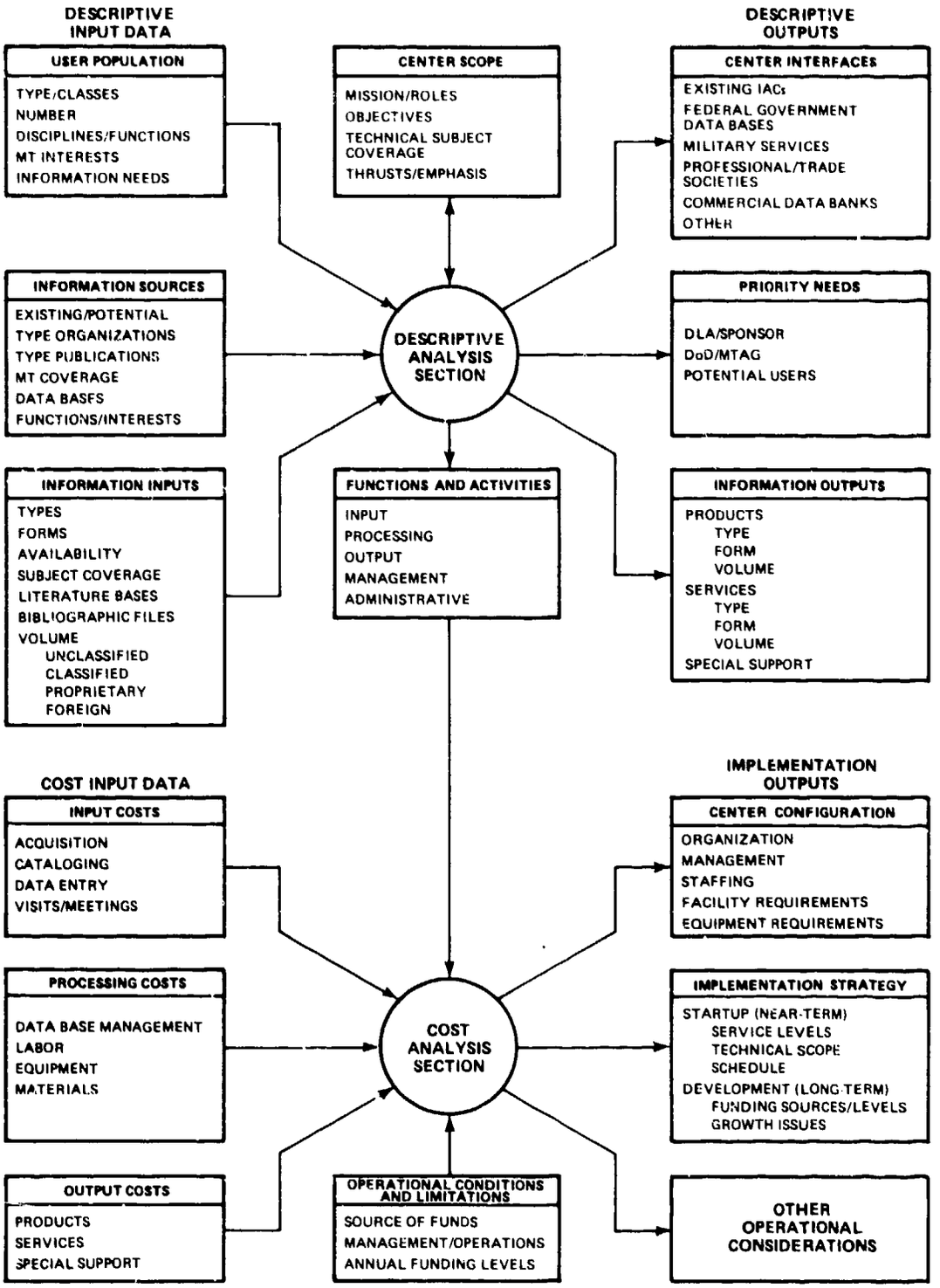

Figure 3-2. Approach to development of the idealized MTIAC model.

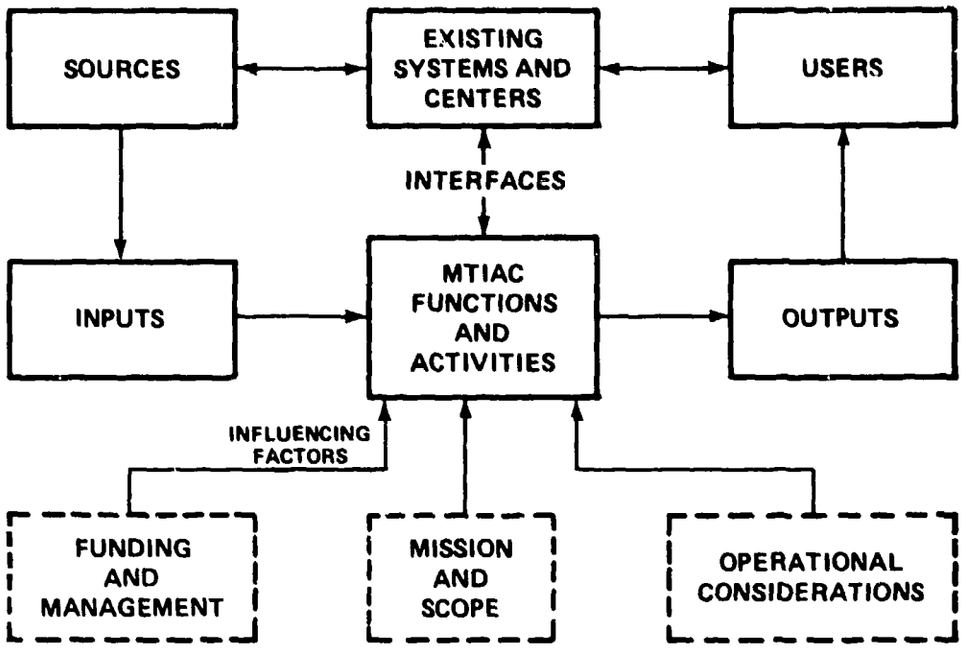

Figure 3-3. Conceptual framework of ideal MTIAC model.

- The interface requirements with existing information centers and DOD, military, and other MT data bases
- The potential sources of information to the MTIAC and their advantages and deficiencies
- The type, form, and volume of the information inputs to the MTIAC.

Planning elements representing "outputs" of the model as indicated in Figure 3-3 are:

- The prospective MTIAC users and their information needs
- The information products and services the MTIAC should offer to satisfy prospective user needs
- The functions and activities the MTIAC should undertake to provide products and services to the DOD and its contractors.

Major influencing factors considered in defining the model were:

- The funding sources and levels
- The commonalities in management and operations of existing DLA-funded information centers

- The MTIAC mission, role, and scope of technical coverage commensurate with its objectives
- The MTIAC configuration in terms of its organizational structure, staffing, disciplines, and facilities requirements
- The resource requirements corresponding to alternate levels of service and annual funding levels.

Two important concepts of information science are embedded in the conceptual framework of the model: information flow and input transformations. As information is processed in a system or center, it undergoes various transformations which make it desirable to reclassify the information inputs by type and by the forms of each type at various stages of the process. Five major categorizations of information are the most useful in the analysis of information systems and centers, and they are based on the recognized sequence of transformations:

1. Real-world inputs. Information is first categorized by the way in which it occurs in the real-world environment, by its form or mode of occurrence. Information as it occurs in real-world "packages" (e.g., reports, books, serials, bibliographies, etc.) is the "raw material" (acquisitions) for processing by the system and as such, its properties are of prime importance in the analysis.
2. System-oriented inputs. Information is also classified by its inherent nature, i.e., by its content type (e.g., abstract, citation, etc.). This categorization concerns the individual information items which may be found within the environment-oriented inputs.
3. System stores. Information is further classified by its position and use in the system stores or document collection. These stores provide both the archival storage of information (e.g., full text) and the surrogates for manipulation of the stored information (e.g., indexes, abstracts, thesauri).
4. Initiative outputs and services. One of the main functions of an information analysis center is to actively disseminate information to the user population. As a result, information must be classified in terms of the types of initiative outputs and services which the center is to provide.

5. Responsive outputs and services. The other main function of the system is to provide services in response to user requests. Information must, therefore, be categorized in terms of the types of responsive outputs and services to be provided by the system.

MTIAC Model Analysis

Following construction of the model, an analysis was made to ascertain the need for an MTIAC and the desirability of establishing a center based upon the inputs to the model derived from the user survey and existing systems review. The most critical questions in this analysis were how well the existing information sources are satisfying the needs of potential users and what benefits are to be gained by establishing a center. The objectives of the analysis were to:

1. Identify and prioritize the functions of the idealized model which could be performed by the MTIAC to provide the greatest overall benefit to the DOD and its contractors. Consideration was given to viable combinations of the following conditions:
   a. Source of Funds (OSD/Services)
   b. Management/Operations (OSD/Services/Contractor)
   c. Annual Funding Levels ($400K to $700K/$700K to $1000K/Over $1000K).
2. Synthesize the results of the review of current management and operations of existing DLA-funded IACs to facilitate the development of alternative MTIAC concepts.
3. Compare the advantages and shortcomings of complete/open usage of the system with that of initial limited access to facilitate the evaluation of viable MTIAC startup strategies.

The analysis of the model also included an evaluation of the most appropriate MTIAC concept and system configuration among the alternatives developed. Criteria for the evaluation included such factors as:

- The degree to which the need for an MTIAC would be satisfied
- The cost effectiveness of the approach

- The likelihood of acceptance by users
- The ability to acquire and process the necessary inputs.

MTIAC IMPLEMENTATION AND STARTUP STRATEGY

MTIAC Implementation Plan

Figure 3-4 summarizes the development factors and the planning considerations relevant to each factor for the "initial" implementation and "future" development periods of the center. This outline was used as a "planning framework" to guide the design of the initial and future center concepts and as a checklist of the important factors requiring consideration for implementing and developing the center.

In addition to the factors listed in Figure 3-4, other important considerations that may impact the implementation of the MTIAC were investigated. The more significant of these are listed below and discussed in the paragraphs that follow:

- Commonalities in management and operations of existing DLA-funded IACs
- Dissemination control requirements
- Export-limited critical technology control
- Support to MTAG.

IAC Management and Operations Commonalities

All DOD IAC activities, regardless of technical charter, operate within the broad guidelines set forth by DOD Instruction 5100.45, "Centers for the Analysis of Scientific and Technical Information." Each of these centers provides the following functional services:

- Identification, acquisition, and cataloging of scientific information within a technical scope established by DOD
- Preparation of analyses, critical reviews, surveys, data compilations, and manuals, and performance of other analysis tasks to serve user community needs
- Dissemination of information via reports, seminars or conferences, and personal consultations.

While all DOD IACs have common or similar characteristics in terms of services provided and basic organization structure, each center differs substantially in operation, depending on the needs of the user community that it serves. Some DLA centers, such as TEPIAC,

MTIAC DEVELOPMENT FACTORS	PLANNING CONSIDERATIONS	
	FOR INITIAL DEVELOPMENT PERIOD	FOR FUTURE DEVELOPMENT PERIOD
I. SIGNIFICANT EVENTS	1. INVESTIGATE FEASIBILITY OF A DOD MTIAC 2. ESTABLISHMENT OF DOD MT ADVISORY GROUP 3. DEVELOP/SOLICIT IAC CONCEPTS 4. EVALUATION OF IAC CONCEPTS 5. SELECTION OF PREFERRED CENTER CONFIGURATION 6. DESIGN AND IMPLEMENTATION OF INITIAL PRODUCTS/SERVICES 7. INITIAL PHASE OF OPERATION 8. INITIAL ACQUISITION PROGRAM	1. MATURING OF CENTER 2. MATURING OF DATA BASE 3. GOVERNMENT ACTIVITIES DUE TO MT CONCERNS 4. INCREASE IN FOREIGN COMMUNITY INTERESTS AND REQUESTS 5. REEVALUATION OF SYSTEM AND ORGANIZATION 6. OTHER
II. POLITICAL, ECONOMIC, AND TECHNOLOGICAL ENVIRONMENT	1. ADMINISTRATION AND CONGRESSIONAL POLICIES 2. DOD, AMMRC/DLA, OTHER POLICIES 3. CLIMATE OF PUBLIC AND PRIVATE OPINION 4. AVAILABILITY OF FEDERAL FUNDS 5. SIZE OF DLA BUDGET 6. BUDGETARY ALLOCATION TO PLAN AND ESTABLISH CENTER 7. ORGANIZATIONAL AND STAFFING CONSTRAINTS 8. AVAILABLE SYSTEMS AND EQUIPMENT	1. SAME AS FOR INITIAL PERIOD, *IN ADDITION* 2. NEW, FEASIBLE TECHNOLOGICAL DEVELOPMENTS 3. AVAILABILITY OF OTHER FUNDS 4. ORGANIZATION AND STAFFING CHANGES 5. OTHER
III. MTIAC USERS AND THEIR INFORMATION NEEDS	1. IDENTIFICATION AND DESCRIPTION OF USERS 2. NUMBER OF USER COMMUNITIES AND ORGANIZATIONS 3. ESTIMATED GROWTH OF USER COMMUNITIES 4. GEOGRAPHIC LOCATIONS OF USERS 5. PRIORITY USERS TO BE SERVED 6. STATED AND IMPLIED USER NEEDS 7. USER COMMUNITY PRIORITIES 8. MTIAC PROMOTIONAL PROGRAM	1. CONFIRM NEEDS OF RESEARCHERS 2. CONFIRM NEEDS OF DATA BASE 3. NEW NEEDS OF DOD AND GOVERNMENT AGENCIES 4. PROGRAM TO SOLICIT USER SATISFACTION DATA FROM USER ORGANIZATIONS 5. ESTABLISH COMMUNICATION WITH NEW ORGANIZATIONAL USERS 6. USER CHARGE PROGRAM (COST RECOVERY)
IV. LITERATURE BODY, BIBLIOGRAPHIC RECORD, AND OUTPUT PRODUCTS/SERVICES	1. TYPE OF LITERATURE AVAILABLE 2. FORM OF AVAILABLE LITERATURE AND MATERIALS 3. SUBJECT CONTENT OF LITERATURE 4. SIZE OF LITERATURE BODY/TRANSFER OF COLLECTIONS 5. ESTIMATED GROWTH OF LITERATURE BODY 6. MTIAC GENERATED PRODUCTS PRIORITIES 7. DEVELOPMENT OF BIBLIOGRAPHIC DATA FILE 8. CONTINUING ACQUISITION PROGRAM	1. ADJUSTED ESTIMATE OF LITERATURE BODY GROWTH 2. BIBLIOGRAPHIC FILE ACTIVITY 3. EFFECTIVENESS OF VOCABULARY CONTROL AIDS 4. ADJUSTED MTIAC GENERATED PRODUCTS WORKLOAD 5. ADDITIONAL SERVICES NEEDS 6. SUBSTANTIAL INCREASE IN FOREIGN LITERATURE
V. OTHER RELATED INFORMATION	1. EXISTING SYSTEMS AND CENTERS 2. EXISTING SYSTEMS INTERACTION/NEEDS 3. FREEDOM OF INFORMATION ACT 4. EXISTING COMMUNICATION PATTERNS 5. EXISTING SYSTEM PROCESSING 6. CHARACTERISTICS OF EXISTING COLLECTIONS 7. INFORMATION ACTIVITIES OF PROFESSIONAL ASSOCIATIONS AND EQUIPMENT MANUFACTURERS	1. RESOURCE SHARING AGREEMENTS 2. INCREASE IN COOPERATIVE SERVICES 3. ESTABLISHMENT OF UNION LIST OF HOLDINGS 4. INTERACTION WITH OTHER RESEARCH AND DATA CENTERS (IACs) 5. OTHER

Figure 3-4. Considerations for development planning of MTIAC.

deal heavily in critically evaluated numerical data, and their outputs are oriented more toward data manuals. Other centers are built around data bases that combine numerical data and textual information. MCIC outputs, for example, concentrate heavily on handbooks and databooks. Specific areas addressed in the study included an evaluation of the influence of combinations of factors such as sources of funds, differences in management/operations, and annual funding levels.

Dissemination Control Requirements

An important task of the study was to evaluate the desirability of including information with restricted access or dissemination as part of its data base. User benefit requirements for restricted information were compared to the costs and time involved in the setup and maintenance of control procedures for:

- Personnel access to information files
- Electronic/optical access
- Central control versus distributed keys
- National security (classified) information
- Proprietary data.

The costs and time were investigated for various methods of assuring control not only for the access and dissemination of information, but also for information regrading or reclassifying (upgrade or downgrade).

As part of this task, current practices in existing IACs pertaining to security/proprietary data control and dissemination were reviewed and evaluated. Among the items reviewed, for example, were procedures relevant to user visits and document distribution.

Export-Limited Critical Technology Information Control/Dissemination

The study also addressed means of coordinating control keys with current, updated DOD and Department of Commerce foreign technology dissemination regulations and their interpretation or implications. Identifying workable processes that can accurately locate and regrade relevant technology elements was an important element of this task.

Attention was also given to those classes of information that fall within the categories subject to U.S. export controls. For example, in a task force study conducted by DARPA in 1977, some of the new technology classes that parallel MT subject areas were identified as:

Advanced Material Technologies

Composites and Composite Structures Technology

Metals and Alloys Technologies

Polymers Technologies

Advanced Manufacturing Technologies

Automation Technology

High Rate Sputtering Technology

Ceramic Processing Technology

Nondestructive Evaluation

Automated Test Equipment

It was felt that if the MTIAC mission is to serve industrial societies/associations, individual U.S. firms, and academic institutions that may interact with foreign counterparts as a matter of routine, then all forms of MTIAC outputs may have to be carefully screened.

MTIAC Support to MTAG

A key element in planning the initial and future development of the MTIAC will be the continuing support the center will provide to the MTAG and its technical subcommittees. During the conduct of the study, meetings were held with MTAG and some of its subcommittee members to ascertain the nature, extent, and requirements for information support that they will expect the center to provide.

MTIAC Startup Strategy

Realistically, it will require several years for an MTIAC to reach the desired level of effectiveness and capabilities. Data bases must be developed and implemented. Publications must be designed and launched. Communication channels must be established with DOD elements, and a user base must be developed. These activities alone could probably take a minimum of 2 years.

Because of the wide variety of activities the MTIAC could undertake and the diverse number of approaches that could be taken, it was an important task of the study to carefully develop the center's startup strategy. The sequence and priorities of startup activities, as well as the scope of services offered, were important elements in planning the implementation of an MTIAC. The startup strategy was structured in a manner that allows an MTIAC to show positive benefits for each activity. For example, by initially focusing on the dissemination of completed DOD MT project results, the center could quickly demonstrate its value as a technology transfer agent and enhance its acceptance by users.

OPERATIONAL CONSIDERATIONS

Significant Factors

The effectiveness of an MTIAC will be determined primarily by the level of funding and the activities undertaken by the center. Other operational factors, however, will also be determinants of the center's effectiveness. A number of the more important of these factors were reviewed and evaluated in the study. Among these were the following:

- Related program interfaces
  - -- DOC-cooperative technology program
  - -- NTIS-center for utilization of federal technology
  - -- NASA-industrial/state technology application centers
- Breadth of technology coverage
  - -- Users/usage versus constrained/unconstrained
  - -- Classification scheme for structuring MT data base
- Information control/dissemination safeguards
  - -- Classified information
  - -- Proprietary information
  - -- Export-limited critical technology
- Information access and flow
  - -- MT projects data
  - -- MT implementation and benefits
- Cost recovery program
  - -- Service charges system
  - -- Market analysis for user charges
  - -- Disadvantages of user charges.

Associated MT Issues

There are a number of socioeconomic issues that are directly relevant to manufacturing that were also considered in planning the scope of interests and concerns of the MTIAC. It was felt that there are established precedents among the present DLA-administered IACs and other DOD IACs to include such information in the MTIAC if the study confirmed the need. The following associated issues were reviewed for their impact on the MTIAC activities and technical coverage:

- Environmental concerns in the use of hazardous materials and toxic liquids in the manufacture of DOD end-products
- Occupational safety and health concerns such as noise levels, storage and handling of toxic chemicals, control of noxious fumes, and monitoring of OSHA regulations
- Critical raw material substitutes and related concerns for frequently used materials in short supply
- Energy conservation and concerns of energy intensiveness of various manufacturing processes and systems required for production of DOD materiel
- Economic statistics, particularly those relevant to capital equipment investments and incentives to improve industrial productivity.

SECTION 4

EXISTING INFORMATION RESOURCES REVIEW AND EVALUATION

EXISTING SYSTEM DESCRIPTION

The diversity and complexity of the MT user community is reflected in the information system which now exists to satisfy their information needs. For the most part, the individual members of the MT community are dependent upon information resources peculiar to their vocation or disciplines. At best, these resources have only a superficial resemblance to what may be considered a legitimate element of an existing MT information system. Therefore, in describing the existing system, the following discussions are limited to information resources that are professionally staffed and can be identified as information centers, technical libraries, and other services directly or indirectly concerned with the collection and dissemination of MT information.

System Elements

Figure 4-1 depicts the existing MT information system as two interactive networks. Information is transferred between the users and the two networks and among the elements of each network as shown. The figures in the information-oriented network represent the approximate number of significant MT data bases or collections in each element. An analysis of the information flow between the two networks and users shows that the existing system is unable to integrate DoD MT program results and developments to give every type of user within the MT user communities an overview of total MT activities. For convenience of discussion, the existing system depicted in Figure 4-1 will be divided into its information-oriented and MT-oriented networks.

Information-Oriented Network

Basically, the information-oriented network of the existing system for acquiring and disseminating MT information can be grouped into the following seven major components:

- DLA-administered IACs
- Professional societies, industry and trade associations, and advisory organizations

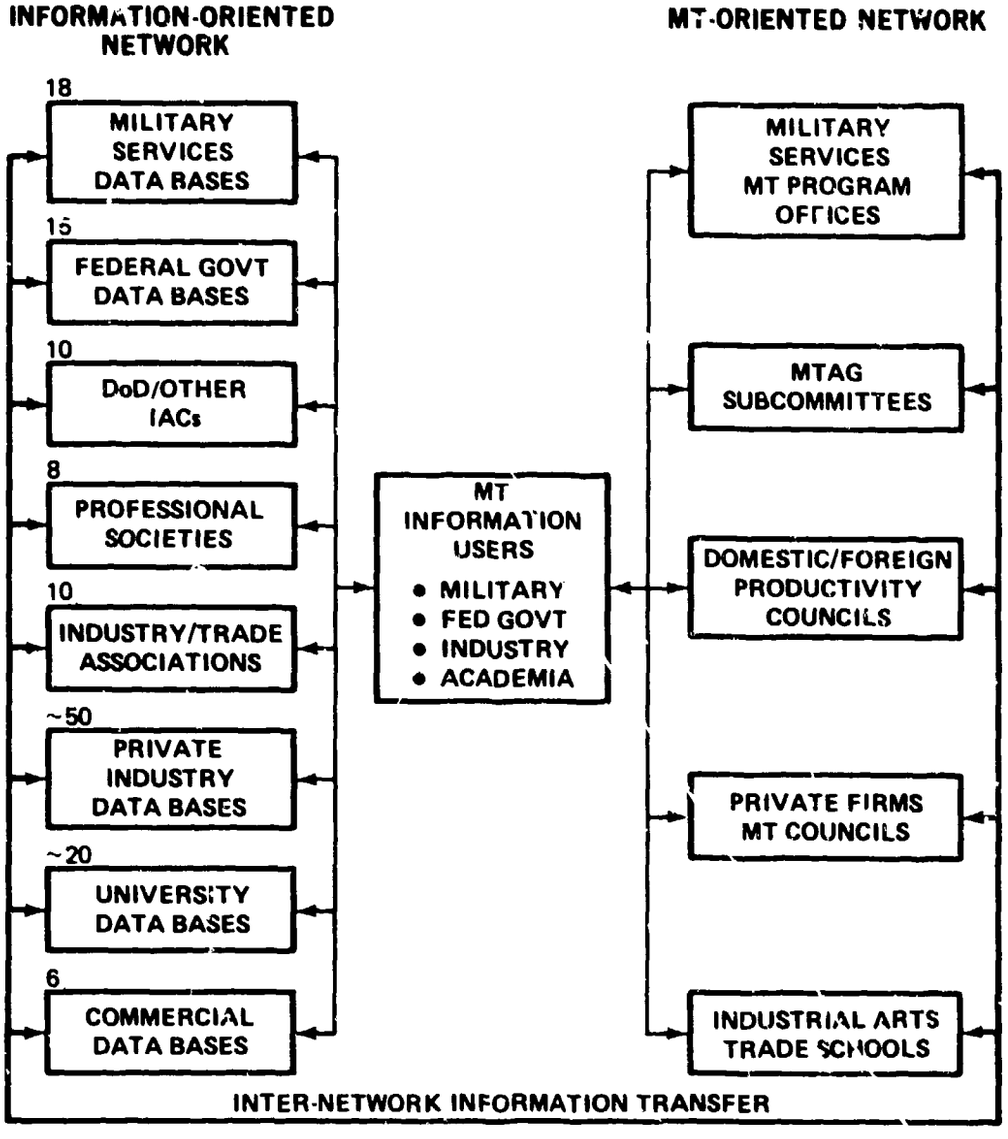

Figure 4-1. Existing MT information system.

- Military service data bases
- Other federal agency data bases (including DTIC and NTIS)
- Commercial data bases
- Private industry data bases
- Universities and trade schools.

It should be noted that these system components comprise organizations that would serve as both potential sources and users of an MTIAC. For convenience, the organizations are categorized and listed by component in Tables C-1 through C-5 in Appendix C. The following paragraphs briefly discuss each of the information-oriented components of the existing system.

DLA-ADMINISTERED IACs. Table C-1 in Appendix C identifies the DLA-sponsored IACs contacted and evaluated during the study. Initial telephone contacts with the nine DLA-funded IACs determined that the Infrared IAC and the Tactical Weapons Guidance and Control IAC would not be significant MTIAC interfaces. Therefore, these two centers were not sent a followup letter (see Appendix B) soliciting detailed data concerning their operations.

The Infrared IAC indicated that it does receive some MT reports on infrared detectors, about three-fourths of which are proprietary, but they do not prepare state-of-the-art reports or produce any other products related to MT. Although the Guidance and Control IAC lists manufacturing process development as one of their technical subject areas, they become involved in this area only if a cursory search of specific information is requested. Their primary concern is with recent developments in guidance and control, and engineering data associated with detection, acquisition, and tracking of targets.

PROFESSIONAL SOCIETY DATA BASES. The professional societies, industry and trade associations, and advisory organizations contacted during this study are listed in Table C-2 in Appendix C. Half of the organizations listed are members (or former members) of the MTAG Executive Committee or Technical Subcommittees. The majority of the organizations are interested in possibly using an MTIAC as an MT data base for their memberships. Others have expressed a willingness to include an MTIAC on their mailing lists of publications and of new or revised documents by their organizations. Still others have indicated that perhaps their best involvement in diffusing MT information would be to ensure that their memberships are aware of an MTIAC and to encourage their use of its services.

MILITARY SERVICE DATA BASES. Table C-3 in Appendix C lists the existing military service data bases identified during the study. It is anticipated that these data bases would interface heavily with an MTIAC as key sources of MT information or be moderate-to-frequent users of the center. A key source of MT projects data for the Army MT program will be the Army's MT Management Information System.

ARMY MT MANAGEMENT INFORMATION SYSTEM (MT MIS). This is a significant data base that has been operational since August 1978. The MT MIS was developed and implemented by the Army's Industrial Base Engineering Activity (IBEA) in Rock Island, Illinois, at the direction of DARCOM's Office of Manufacturing Technology. Its primary

purpose is to aid in the management and evaluation of the Army's MT program. The system also facilitates MT project formulation/review and interservice coordination. Authority to directly access the MT MIS data base for project information retrieval has been granted to all Army elements involved in the MT program. Direct accessing and accessing through IBEA have resulted in a substantial growth of MT MIS usage since its was implemented.

OTHER FEDERAL DATA BASES. A list of other federal data bases identified as potential sources of MT information during the study is presented in Table C-4 in Appendix C. Analyses of the functions of these sources indicate that they would most likely have significant interface with an MTIAC. In addition to the data bases identified in Table C-4, the DTIC and NTIS data bases should also be expected to contribute a significant volume of data to an MTIAC.

DTIC BIBLIOGRAPHIC DATA FILE. The advantages of installing an MTIAC bibliographic data file on the DTIC computer should be examined during the early phases of MTIAC implementation. It is expected that an MTIAC would benefit by using software and computer equipment that is currently operational so as to avoid duplication of work already performed by DTIC. There would be a GFE cost for the in-house terminal to access the DTIC computer system. Hardware specified by DTIC for remote site access to its RDT&E On-Line System is a Uniscope 200 terminal and a high-speed printer. Another cost factor to consider is whether any portion of the expected MTIAC data base will involve classified data. Once this has been determined, it will dictate whether the remote terminal will operate in an "unclassified" or "classified" mode. Secure terminals require the additional expense of a dedicated line for communication.

At this time, it would appear that the best interface with other DOD IACs would be via the DTIC RDT&E System central computer. This assumption is applicable only if all IAC data files of interest are installed on the DTIC computer. Some future discussions should be carried out with DTIC to determine if future system developments will allow IAC files to be "merged" for a single search of all files and whether unified bibliographic outputs could be prepared. This could pose some operational difficulties because of different cataloging terms or subject-heading structures or classification schemes used by other centers.

DTIC DATA BANK (DD FORM 1643). This data bank for Research and Development Program Planning was established in 1970 and is updated annually in September, providing an overview of DOD-wide R&D planning. The file may prove useful to an MTIAC for supporting MTAG program reviews and identification of duplication or gaps in DOD-funded research programs. Significant information available includes program start/completion dates, RDT&E funding, and responsible contracting organizations.

DTIC WORK UNIT DATA BANK (DD FORM 1498). This data bank consists of a periodically updated file of DOD R&D program-in-progress reports on project status, plans for next period of work, and reports in preparation or issued by project. Its usefulness in an MTIAC should be evaluated during the center's first year of operation.

DTIC DOD REPORTS FILE (DD FORM 1473). DTIC provides authorized DOD IAC activities with a current-awareness bibliography of recently received DOD-funded research classified and unclassified reports which match a field of interest profile filed by each center. In addition, hard copy of microfiche copies of desired reports can be ordered from DTIC for retention by the center. A preliminary assessment of this data bank indicates that it could serve a useful purpose to an MTIAC.

NATIONAL TECHNICAL INFORMATION SERVICE (NTIS). The NTIS is the central point in the United States for the public sale of government-funded R&D reports and other analyses prepared by federal agencies, their contractors, or grantees. While no federal agency has the responsibility for collecting and translating or writing about MT developments in the private sector in the United States, NTIS has a readymade organizational structure to absorb, organize, and distribute the literature to American industry. However, the survey of existing systems indicated that large segments of industry most in need of NTIS publications on MT do not subscribe to this service. A conservative estimate of MT coverage in the NTIS collection is less than 10 percent.

NTIS TECH NOTES. The Tech Briefs Series is a subscription service initiated by NTIS to alert the user community to current applied technology development. The NASA Tech Briefs have been converted to a computer-based file and cover 11 major technical categories including:

Computers	Manufacturing
Electrotechnology	Materials
Energy	Ordnance
Engineering	Physical Sciences
Life Sciences	Testing and Instrumentation
Machinery	

The current NTIS Tech Notes Series on MT sponsored by the Army Materials and Mechanics Research Center (AMMRC) will also play an important role in an MTIAC in diffusion of MT development results to the private sector.

COMMERCIAL DATA BASES AND INFORMATION SERVICES. Among the commercial data bases reviewed and evaluated during the study, the most important, in terms of significant MT data sources, are:

- DIALOG
  Lockheed Missiles and Space Center
  Palo Alto, California
- ORBIT
  System Development Corporation (SDC)
  Santa Monica, California
- ISMEC
  Data Courier, Inc.
  Louisville, Kentucky
- Production Engineering Research Association
  (PERA) of Great Britain
  Leicestershire, England

Lockheed's DIALOG and SDC's ORBIT are large on-line information retrieval services that are subscribed to by many potential MTIAC users. These services obtain and process data bases for computer retrieval, furnish back-up documentation, train subscribers in search methods, provide special "update" user seminars, and offer subscribers special help with difficult search problems. Both DIALOG and ORBIT are fully commercial systems marketed to many organizations with MT interests.

The DIALOG and ORBIT systems are representative of remote terminal information retrieval services which are relatively new but spreading rapidly. Currently, there is a $200 million commercial industry of remote data base publishing, consisting of terminal-based services offering financial and brokerage news, and legal, technical, and scientific data bases. These services offer significant advantages--greater added value--over print or microform services, along the following dimensions:

- Currency--a computerized data base can be updated continuously. This is a matter of relatively great importance in certain areas (news, brokerage data), and of relatively less importance for technical and scientific data.
- Capability of doing interactive searching--in contrast with the batch computer searching methods, the computer-user dialog process is much faster and more effective. Since the computer responds in seconds, the user does not need to exercise painstaking care in query formulation. Compared to manual or batch computer searching, there is far greater search selectivity in response to individual search needs, to overcome the signal-to-noise problem inherent in use of general-purpose data bases. Powerful search logic enables high selectivity of information items and an ability to reject irrelevant

information out of hand. The selectivity is made possible through the man-computer dialog process.

- Capability of accommodating large volumes of data--hundreds of thousands or millions of items can be searched, the equivalence of looking through entire library shelves.

Data Courier, Inc. produces ISMEC, a machine readable data base which cites, indexes, and indicates major topics in international literature on mechanical engineering, including MT. Approximately half of the data base content are journal article citations, and the remainder are conference paper and book citations. This data base can be accessed on the Lockheed DIALOG and the SDC ORBIT on-line systems, or it can be leased on magnetic tape directly from Data Courier. It is anticipated that this data base would be a significant source of information for an MTIAC.

PERA of Great Britain provides a current-awareness service in MT that is tailored to individual requirements. Subject coverage includes metal machining, metal forming, castings, inspection, materials handling, packaging, safety, and other topics.

PERA's library is believed to be the largest in Europe devoted mainly to production. It has more than 350,000 reports, books and periodicals, a computerized data retrieval system, an extensive collection of British Standards and trade literature on microfilm, and a coordinate index system for machine tools. Over 600 technical, scientific, and commercial journals are received each month and relevant information from them is abstracted in the PERA Bulletin (five issues a year).

In addition to the individually tailored current-awareness bulletins, PERA services include literature searches, product surveys, and data collection; staff training in information storage and retrieval; and development of technical libraries and information centers in industrial and business firms.

PERA's services are sold in two ways: (1) annual subscriptions to member companies, and (2) special information services available to members and nonmembers, costed on a manhour rate plus overhead. Distribution of the PERA Bulletin is restricted to members. Any manufacturing firm in the United Kingdom is eligible to apply for membership and offshore applications are also considered. PERA's services are not restricted to information, but also include R&D, consulting, and training on its 28-acre site.

The potential interface of PERA with an MTIAC requires additional investigation. Communication to date has been exclusively by private correspondence during the conduct of the study. PERA appears to be a broad-based MT information center whose members are drawn from a wide

range of industries, including but not limited to defense-related industries. Although PERA could be a significant source for or interface with MTIAC, it may be found that its services are duplicative of services available in the United States and/or very costly. Implementation of an interface relationship may also be difficult and costly since PERA is not located in the United States.

PRIVATE DATA BASES. Table C-5 in Appendix C lists a sample of private data bases with significant MT holdings that are operated and maintained by industrial firms in the United States. The subject coverage of the data bases and the nature of their holdings are also summarized in the table. The six data bases listed in the table are intended only as examples of the diverse cross section of data bases in private industry of significant size and dedication to MT areas of interest. Other private-industry data bases with parts of their total collections devoted to MT can be identified from a detailed review of the directory of special libraries and information centers cited in Table C-5.

UNIVERSITY DATA BASES. A number of States, such as Georgia and North Carolina, have established MT or "productivity" centers, usually centering on the State technical university. For example, the School of Engineering, North Carolina State University, has an Industrial Extension Service which provides "technical and managerial resource service for North Carolina business and industry." The university provides extension education, technical and managerial information services, and consulting services designed to analyze a company's managerial or technical problems and to refer the firm to the proper source for resolving the problem.

An example in Pennsylvania is the Pennsylvania Science and Engineering Foundation established in 1967 which is primarily State funded. It has programs for aid to small business, technology transfer, and a network of interrelated programs involving 146 colleges, universities, and technical schools.

The Massachusetts Institute of Technology (MIT) also has an active program in MT education and maintains a large literature collection relevant to advances in MT throughout the world.

MT-Oriented Network

Figure 4-1 outlines the five elements which constitute the MT-oriented network of the existing system. These elements also play an important role in the generation and transfer of MT information and will serve as key MTIAC sources and users. The MT-oriented components of the system are briefly discussed in the following paragraphs.

MILITARY MT PROGRAM OFFICES. Each of the military services has a central MT office responsible for identifying, funding, and managing a servicewide program that addresses high-cost manufacturing problems. The management structure for the DOD MT program showing the key organizations in each of the military services is illustrated in Figure 4-2. The figure also indicates the key military agencies that manage the MT program for each of the services.

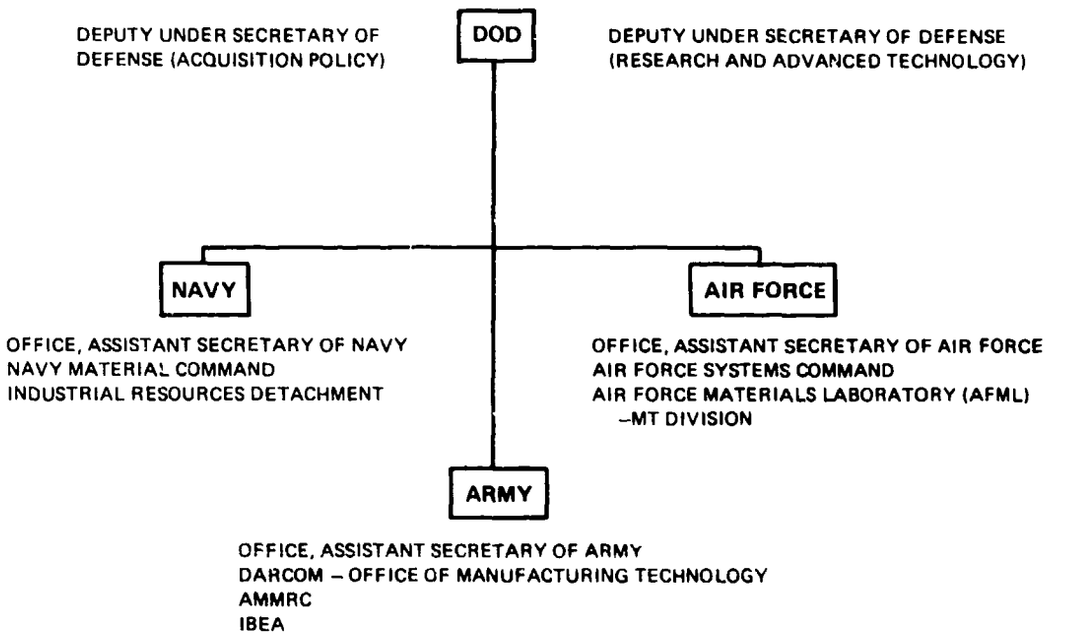

Figure 4-2. DOD MT program management structure.

Dissemination of MT information by the MT program offices is accomplished through various means in order to widely publicize MT program results. This information is disseminated in the following ways:

- Coordination of programs with program managers, contractors, and other government agencies
- Distribution of reports and other documents:
  - -- Project Summary Reports
  - -- MT Notes
  - -- MT Bulletins
  - -- ManTech Journal (Army-sponsored)
  - -- Effectiveness Report

-- MT Accomplishment Brochure

-- Reports available through:

Defense Technical Information Center (DTIC)

National Technical Information Service (NTIS-Department of Commerce)

Government/Industry Data Exchange Program (GIDEP)

- Conferences and seminars
- Industry demonstration
- Interface with Producibility Engineering and Planning (PEP) activities
- Articles in trade journals and other publications
- Films and exhibits.

MTAG AND ITS SUBCOMMITTEES. A key factor in the success of the MT program is close coordination and cooperation in program efforts between the military services MT program offices. To coordinate these efforts, DOD established the Manufacturing Technology Advisory Group (MTAG) composed of an executive committee and six technical subcommittees, as shown in Figure 4-3. This group reviews the planning and implementation programs and accomplishments of each MT office to identify duplication of effort, potential joint efforts, and technological voids in the overall MT effort.

Key elements in MTAG's mission are to:

- Improve the responsiveness and efficiency of the U.S. production base by promoting technology diffusion and broad implementation of innovative MT among the military services, industry, and other government agencies
- Encourage the use of standard documentation formats among the services in their MT programs
- Promote the reduction of weapon system costs and production lead times by encouraging the use of advanced technologies in U.S. industry.

The MTAG Executive Committee includes two representatives of the Office of the Under Secretary of Defense Research and Engineering, one of whom is chairman, and representatives from each military service. Meeting no less than four times a year, this committee provides broad policy guidance and translates policy guidelines into specific goals and objectives. Their purpose is to promote integration of Army, Navy, and Air Force programs into a coherent, DOD-wide MT program.

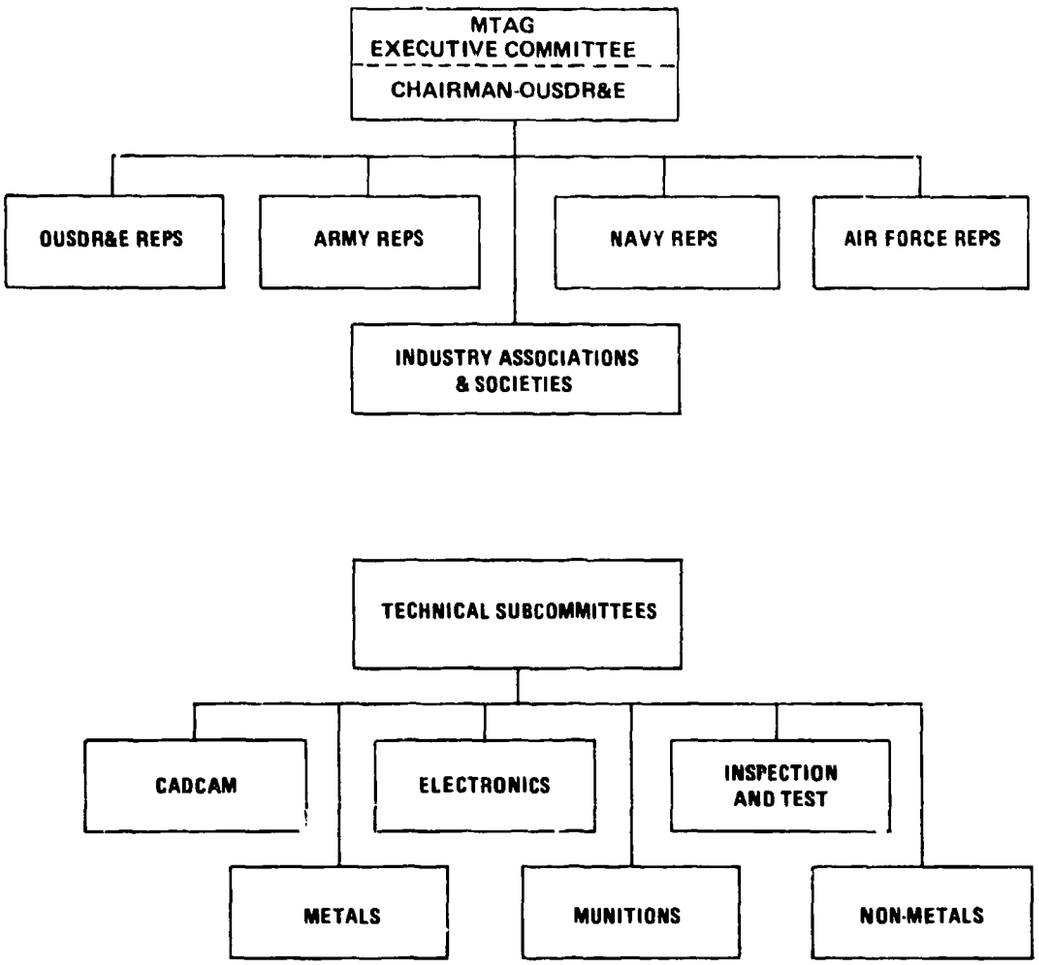

Figure 4-3. Committee and subcommittee structure of MTAG.

The technical subcommittees cover six subject areas: metals, nonmetals, electronics, computer aided design and manufacture, munitions, and inspection and test. Each subcommittee meets at least three times a year. Subcommittee members are nominated by the military service members of the Executive Committee. The subcommittees provide technical analysis, joint planning, and coordination on MT projects in their subject areas; identify areas of concern and possible duplication; and propose courses of action to alleviate inefficient manufacturing processes.

PRODUCTIVITY CENTERS AND COUNCILS. Virtually all the industrial nations of Europe and Japan have established formal productivity centers to develop, promote, and enhance productivity in their respective countries. These centers generally focus on management

technology and productivity improvement in the service sectors of their economies. Concerning management technology, the centers are institutions which accomplish goals similar to those of U.S. graduate schools of business, organizations such as the American Management Association, and management consulting firms. Business education at the university level has generally not reached the high levels in foreign countries that it has in the United States. While there is a certain informing role played by these centers, they do not play a major role in the process of MT invention, innovation, or diffusion.

MT productivity efforts for private industry are carried out by loosely knit yet cohesive consortiums of governmental, academic, private industry, trade associations, societies, and labor unions. In many ways, these consortiums resemble the institutional arrangements for agricultural development, energy development, and space exploration in the United States, but direct comparisons are not appropriate.

The United States has no comparable institutional arrangements and no formal national productivity or technology development goals. The National Center for Productivity and Quality of Working Life, which was given statutory authority in November 1975, replaced the National Commission on Productivity and Work Quality, which was in existence since 1971. Both of these organizations were created in an attempt by the United States to provide a national productivity focus. However, the center has not yet involved itself in MT information transfer.

The American Productivity Center in Houston, Texas, is a nonprofit corporation organized to collect, analyze, and disseminate data and services relating to improving U.S. industry production capabilities. The organization is funded by approximately 200 corporations and individuals and is staffed by approximately 80 persons, including statisticians, educators, and behavioral specialists.

An information services group has a computer terminal that can access data bases at 130 points around the United States to gather detailed information relating to all industrial complexes. The center provides productivity data to companies. It also conducts seminars and provides diagnostic teams that visit companies to analyze their operations and assist the firms in setting up productivity programs.

PRIVATE-INDUSTRY MT COUNCILS/CENTERS. In the private sector, organizations are emerging to address various phases of the problems in MT research, development, and diffusion. The Computer Aided Manufacturing-International (CAM-I), organized in 1972, is devoted to improved productivity through computer software development. It is an international organization not devoted exclusively to improving U.S.

productivity. CAM-I is a nonprofit research organization created by a variety of industries. CAM-I operates with a Business Review Letter from the Department of Justice. A preface to a brochure for its 1975 membership program states that "CAM-I was conceived and organized to provide a focal point for industry, academic, and government communication for the common development of computer applications to manufacturing. It exists to increase productivity." CAM-I has devoted its primary activities to software and standardization problems.

The Work in America Institute, a nonprofit organization, was formed in 1974-75 with private funding. It strives to enhance the quality of working life to strengthen society economically, socially, and politically. It is based on the thesis that advances at the workplace translate into improved living standards, enhancement of mental and physical health and welfare, and increased individual fulfillment, human satisfaction, and dignity.

A "National Center for Manufacturing Technology" (NCMT) has been proposed in the private sector with a goal of developing "a broad, coordinated, advanced technology program" for improving productivity in U.S. manufacturing. The organizers of the National Center have proposed an industry-sponsored nonprofit corporation to act as a focal point for improving U.S. manufacturing productivity, with emphasis on discrete metal part manufacturing. The purpose would be to act as a catalyst for advancing both MT and manufacturing education. In addition to sponsorship of cooperative efforts to achieve practical solutions to actual manufacturing problems, they will perform research of a general interest to a larger number of companies. One planned approach to assure the proper selection of research projects will be the monitoring of the activities of foreign research and development programs and informing their U.S. counterparts of technology advancement. The goal of the educational program will be to assist U.S. industry in applying new technology in their production facilities. The organizers are currently soliciting membership to support the center.

EDUCATIONAL ORGANIZATIONS' MT PROGRAMS. Various institutes, such as the Stanford Research Institute, MIT, and the Illinois Institute of Technology Research Institute, are centers of MT research excellence. But their level of funding and program orientation do not match the efforts in private industry.

Organizations such as the Society of Manufacturing Engineers (SME) are working with universities to diffuse technology and to improve education for manufacturing. Ohio State University, for example, has developed courses in manufacturing for use in secondary schools.

The basic goal of the National Bureau of Standards (NBS) is to strengthen and advance the Nation's science and technology and to facilitate their effective application for public benefit. The NBS staff has a thorough understanding of the problems and potential in computer aided manufacturing. Because of its pivotal role in standardization and technology, NBS is uniquely equipped for a major role in improving productivity in manufacturing.

The purposes of the National Science Foundation (NSF) include: increasing the Nation's base of scientific knowledge and strengthening its ability to conduct scientific research; encouraging research in areas that can lead to improvements to economic growth, energy supply and use, productivity, and environmental quality; promoting international cooperation through science; and developing and helping implement science education programs.

The foundation has a "Research Applied to National Needs" program which is exploring various phases of technology, some of which relate to MT. Because of its experience with such programs, NSF is ideally suited to provide an operating and management interface with the academic community, research institutes, and private enterprise.

EXISTING SYSTEM EVALUATION

Existing System Limitations and Needs

The limitations and needs of the existing system can be summarized as follows:

1. The user needs derived from the user survey described in Section 3 are not satisfied by the existing information system. It is questionable, however, that these needs will ever be fully satisfied or that it is economically feasible to completely satisfy them, even if an MTIAC is established.

2. The first urgent need is to bring a comprehensive collection of all MT information together in one place and under one system of analysis. The MTIAC can serve as such a unifying force.

3. The diversity of indexing languages and approaches, information center contexts, and levels of information center customer sophistication and interests presents severe problems for the development of an MT information network in the near term.

4. No single information facility can acquire all the materials needed by members of the MT user communities. This indicates a dire need for

resource sharing among the various data bases and information centers housing significant MT collections which could eventually lead to a cooperative system or network.

5. Significant elements of the existing system should be encouraged to expand and enhance their MT collections, especially in those specialized areas of particular interest to their specific communities. Compilation of an MT union catalog or development of authority lists should contribute to this goal and at the same time improve the communication among existing information centers and data bases.

6. There is no existing guidebook or directory to MT information resources organized by technical interest area, and there is a lack of the information retrieval skills (in the MT communities) that are necessary to locate and use such resources.

7. One of the major needs is for better mechanisms for maintaining current awareness of latest research papers and reports as they are issued. The time lag between the presentation of a paper or publication of a technical report and the announcement of its availability may be a matter of months. A similar delay occurs between the time a paper is given at a professional society meeting or conference and the publication of the proceedings of the conference. While industry members regularly attend professional society meetings, it is obviously impossible to cover them all.

8. There is a need for a better means of accessing information in existing MT project reports. While there is much valuable information in the reports issued to date, it is cumbersome to sift out needed information.

9. Retrieving results of ongoing MT research at universities is considered difficult but valuable since DOD authorities consider such work of high quality. Dissertation Abstracts, an index of doctoral work from most of the leading universities, does not seem to be widely used by many MT user communities. The availability of this resource should be better publicized.

10. The existing system has no component that is exclusively concerned with the complete spectrum of MT. The system is fragmented in terms of MT interests and concerns, which results in data bases devoted to highly specialized technical areas. Some MT information needs may be satisfied in whole or in part by tapping into one or more of the MT data bases available. Other needs cannot be met by existing data bases because the required MT data either do not exist and must be compiled (for example, robotics data for a specific application), or they exist but are not available in a formal data base and must be gathered through informal communications.

11. There is a high degree of overlap of several of the major applicable MT data bases, each of which might cover a given area only partially. To really assure exhaustivity in coverage, one may have to search them all. This poses a serious problem for the user with limited time and limited familiarity with the differing collections and vocabularies.

12. Other major shortcomings of the present system of MT information resources are:

    a. Nonexistence of data bases in certain critical areas of MT such as automated manufacturing software

    b. Lack of sufficient organization or access provisions for some MT information resources to enable them to be readily used, or unwillingness of their owners to provide good service to the public

    c. Lack of systematic directories that identify specific local MT data bases of relevance

    d. Lack of knowledge about MT information sources or sensitivity as to use of them on the part of users due to proprietary restrictions

    e. Difficulty of access to and use of existing resources and lack of education as to how to access and use them.

Existing IACs' Views of MTIAC Need

Three of the IACs contacted during the study were opposed to formation of a center devoted to MT. Three other IACs agreed that there

was reasonable need for an MTIAC, or at least a focal point for MT information, but perhaps not necessarily a full-scale IAC. Two centers declined to comment.

One of the opinions expressed was that DLA should allocate more funds to existing IACs and expand their technical scope rather than form a new one that would be expensive to start up and operate. Another IAC felt that useful products and services would be difficult to design because the subject is too vast and products such as handbooks or data books would not be particularly applicable, whereas state-of-the-art reviews might have some merit.

However, even those IAC directors who were opposed to an MTIAC recognized that there are unmet needs in the MT area and that there should be a focal point for MT information. For example, it was suggested that this focal point could serve primarily as a unifying function for manufacturing process data. One suggestion was that a focal group may prove useful to obtain input data from existing IACs and to organize them in a manner that could be directly used in manufacturing (process) technology, including cost and other statistical data. However, it was added that this would not require any new action since exchange channels and procedures already exist within the operation of each IAC. Another suggestion was to minimize costs initially and limit the first action to creation of a mission-oriented "information center," not an "IAC" requiring subject specialists and a data base. One center felt that, due to the current need to focus, evaluate, and augment the present available MT information, the chances were that the benefits might well exceed the cost of an MTIAC.

Existing IACs generally recognized the limiting of the technical scope of an MTIAC as a difficult problem. One opinion was that most MT-related subjects are already covered in name, but perhaps not in greatest possible depth by existing centers. For example, it was stated that an MTIAC could not cover essentially all aspects of rocket or gun component manufacture without costly overlap with CPIA. It was also suggested that computer applications might be a costly potential subject area for MTIAC in terms of overlap with some centers. The IAC director offering this opinion, however, did not know of any (federally-sponsored) center covering robotics, automation, automated factories, or CAD/CAM. Another suggestion was that the MTIAC subject coverage should be limited to a manageable size, and that its span should be increasingly reduced and its depth increased in selected areas only.

Some centers felt that there were a number of activities that an MT information center could perform to promote awareness of the MT program, including publication of a DOD-wide ManTech Journal and the continued sponsorship of NTIS Notes as well as a monthly newsletter.

Other centers felt that the same types of products and services now offered by the existing IACs would be logical and appropriate.

One opinion was expressed that an MTIAC should be primarily a "switching center" to other IACs, functioning as a good referral service to other existing MT services. Another IAC director was undecided as to whether an MTIAC should be a fast response center emphasizing immediate manufacturing problems, or a background-information center limited to literature searches, referrals, current MT projects, etc.

POTENTIAL MTIAC INTERFACES

Interfacing With Existing IACs

The results of this study indicate that, based on their subject coverage, the following five DLA-sponsored IACs have the greatest potential for interfacing with an MTIAC:

- Machinability Data Center (MDC), Cincinnati, Ohio*
- Mechanical Properties Data Center (MPDC), Columbus, Ohio
- Metals and Ceramics Information Center (MCIC), Columbus, Ohio
- Metal Matrix Composites Information Analysis Center (MMCIAC), Santa Barbara, California**
- Nondestructive Testing Information Analysis Center (NTIAC), San Antonio, Texas
- Thermophysical and Electronic Properties Information Analysis Center (TEPIAC), West Lafayette, Indiana.

The following centers were found have more limited potential for interfacing:

- Alloys Data Center (ADC), Washington, D.C. (not DLA-funded)

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*As of FY 81, MDC is being run on a private basis by Metcut Research Associates, Inc., its former manager under DLA sponsorship, with no government funding.

**The MMCIAC was newly established in FY 81 and is in its initial operation phase.

- Chemical Propulsion Information Agency (CPIA), Laurel, Maryland
- Reliability Analysis Center (RAC), Griffiss Air Force Base, New York
- Plastics Technical Evaluation Center (PLASTEC), Washington, D.C. (not DLA-funded)
- Shock and Vibration Information Center (SVIC), Washington, D.C. (not DLA-funded).

Table 4-1 summarizes the subject coverage of the above centers. Additional information concerning the activities, products, and services of these centers can be obtained from the following sources:

1. User Guide for DLA-Administered DOD Information Analysis Centers, May 1976
2. Defense Documentation Center Referral Data Bank Directory, DDC/TR-78-2, AD-A055 700, June 1978
3. Directory of Federally Supported Information Analysis Centers, 4th edition, National Referral Center, Library of Congress, 1979
4. User brochures, annual reports, and other literature produced by the centers.

Most of these centers could not foresee any potential incompatibilities in interfacing with MTIAC. However, center directors were concerned that potential problems in interfacing an MTIAC would probably be in the priority of meeting MTIAC demands. In a busy period, the centers could not immediately answer all requests for data. They would have to assess the relative importance of individual requests and treat them accordingly.

The problem of waiting for off-line printouts to a computer search also needs to be considered. Some IACs can run searches quickly and have the capability of printing the results on-line. However, economics and demands on the terminal require the use of off-line service if the number of items to be printed is very high. Lockheed's DIALOG outputs are customarily furnished in less than one week; DTIC service is generally longer than a week. Another problem to be considered would be reimbursement for services, but this should be resolvable. One phase would be payment for time answering a specific inquiry, and another might be for effort in special treatment of a data base, such as additional index terms.

MTIAC and Existing IACs Interfacing Requirements

An assessment of the future role of the MTIAC vis-a-vis the existing system suggests that it will most likely operate in a somewhat

Table 4-1. Subject coverage of existing IACs likely to interface with MTIAC.

IAC	Subjects	
	Materials and Devices	Properties, Processes, and Practices
ADC	Metals, alloys, semi-metallic materials, and intermediate compounds.	Structure-sensitive properties: electronic transport properties, magnetic properties, resonance properties, selected mechanical properties, quantum description parameters, electromagnetic radiation, superconductivity, and thermodynamic properties including phase diagrams.
CPIA	Solid, liquid, hybrid, airbreathing (rocket/ramjet) propulsion systems, fuels, related hardware components, and and gun propellants.	Technical areas: chemical synthesis; manufacturing process development; thermochemistry; combustion and exhaust plume phenomena; physical, chemical, mechanical, and ballistic properties of propellants and fuels; special test equipment and techniques; theoretical performance computations; analytical test techniques; component design criteria; safety and environmental protection measures; materials areas specifically related to missile and space propulsion; and overall propulsion unit operational serviceability.
MCIC	All metals, metal alloys, ceramic materials, composites containing metal or ceramic elements, and coatings for such materials utilized in defense systems and hardware. Emphasis on those materials used in critical structural applications and/or in stringent environments.	Design characteristics, processing, forming, joining, fabrication, environmental effects, test methods, applications, quality control, sources, suppliers, and specifications for materials listed in column 2.

(continued)

Table 4-1. (Continued).

IAC	Subjects	
	Materials and Devices	Properties, Processes, and Practices
MDC	All materials including difficult-to-machine materials such as high-strength steels, titanium and titanium-base alloys, carbons and graphites including composites and metal matrix composites; brittle materials such as ceramics and metals (beryllium); high-temperature polymers including composites.	Conventional machining practices: feeds, speeds, depths of cut, tool materials, work materials, cutting coolants and lubricants, machine tools, tool and fixture design, workpiece configurations, finish and tolerance requirements, distortion, residual stress, and all other aspects relating to surface integrity of machined workpieces or products. Nonconventional material removal practices: electrical discharge machining, electrical discharge grinding, electrochemical machining, electrochemical grinding, chemical, ultrasonic, electron beam, and laser beam machining. Other information: economic aspects of the machining industry such as equipment and tool life, maintenance and preventive maintenance programs, economic considerations regarding selection of machining process, and industry trends including numerical control, adaptive control, and other automated machine tool adaptions.
MMCIAC	Technology related to metal matrix composite materials including application of these materials in defense systems.	Continuous fibers, discontinuous whiskers, and directionally solidified eutectics. Properties: specific strength, specific modules, fatigue, environmental response, creep and wear resistance. Technical areas: manufacturing, fabrication process development, test and evaluation techniques.
MPDC	Low-alloy steels, stainless steels, tool steels, superalloys, maraging steels, cast	Mechanical properties: data from all standardized or conventional mechanical properties tests are incorporated in a computerized storage-retrieval-display system. Standardized mechanical properties tests include:

(continued)

Table 4-1. (Continued).

IAC	Subjects	
	Materials and Devices	Properties, Processes, and Practices
MPDC (cont)	iron, nickel/chromium base alloys, aluminum alloys, titanium alloys, magnesium alloys, tantalum alloys, molybdenum alloys, beryllium alloys, tungsten (wolfram) alloys, columbium alloys, and dissimilar metal joints (limited copper, silver, zinc, plutonium/uranium, lead/tin, zirconium, hafnium, paladium, carbon, vanadium).	Tensile--static, impact, creep and stress rupture (constant load and temperature), creep (intermittent load and/or temperature), spot weld, and cross tension Compression--static, creep (constant load and temperature) Shear--block, fastener, punch, sheet, torsional, area joint Bearing--sheet or plate with hardened fixture pin, combined (fastener and sheet or plate) Bending impact--charpy, izod, modified charpy or izod, dropped weight Fatigue--conventional S/N, fatigue crack propagation Fracture toughness--compact tension and bending (ASTM E-24, 1969), tensile (various methods) Stress corrosion Pressure vessel burst.
NTIAC	Metals, nonmetals, composites, and specific components.	Nondestructive testing methodology and instrumentation: testing by radiography, electromagnetics, ultrasonics, optics, and other methods; testability data on metals, nonmetals, composites, and specific components; quality and reliability assessment data (defect characterization, standards, serviceability criteria), and NDT engineering data. Other information: economic aspects of the NT industry, economic considerations regarding selection of techniques and processes, and industry trends in applying current NT technologies in research and development, production, maintenance, safety monitoring, and failure prevention of in-service material.

(continued)

Table 4-1. (Continued).

IAC	Subjects	
	Materials and Devices	Properties, Processes, and Practices
PLASTEC	Plastics, embedding substances, expanded plastics, heat-resistant plastics, isocyanates, laminated plastics, thermoplastic resins, thermosetting plastics, adhesives, acetal resins, acrylonitrile polymers.	Coverage emphasizes, but is not limited to, structural composites, electrical and electronic applications, adhesives, materials applications and processing, microbiological deterioration, test methods and specifications, compatibility and reactivity, packaging/foams, and encapsulation.
RAC	Microcircuits including monolithic bipolar and metal oxide semiconductor integrated circuits, hybrid circuits, thin- and thick-film circuits, and large-scale arrays; discrete semiconductors including transistors, diodes, optoelectronic devices, microwave devices; nonelectronic devices; and standardized electronic modules. Initiation of a system/equipment corporate memory is underway.	Technical areas: reliability and failure mode/mechanisms information that is generated during all phases of component fabrication, testing, equipment assembly, and operation; information and data on R&D studies, process control, QA practices, screening and burning, qualification and environmental testing, failure analysis reliability prediction methods, reliability demonstration and field testing, and mission deployment are incorporated in a hard copy library and computer data base. Specialized services: reliability problems such as reliability assessment and prediction, survey, data analysis, device selection, failure problem investigation, reliability test plans and procedures, and systems reliability/maintainability support to systems reliability/maintainability control programs.

(continued)

Table 4-1. (Continued).

IAC	Subjects	
	Materials and Devices	Properties, Processes, and Practices
SVIC	(The mission of this center is to collect, correlate, and disseminate information on all aspects of mechanical shock and vibration as they affect equipment and materials.)	Dynamic mechanical phenomena: structural dynamics, transportation and service environments (shock, vibration, and acoustics), test techniques and equipment, mathematical analysis and interpretation of environmental data, design, materials properties, and damping.
TEPIAC	Elements, inorganic compounds alloys, intermetallics, glasses, ceramics, cermets, applied coatings, and polymers.	Thermophysical properties: thermal conductivity, thermal contact resistance, accommodation coefficient, viscosity, emissivity, absorptivity, reflectivity, transmissivity, absorptance/emittance, specific heat, thermal diffusivity, Prandtl number, linear coefficient of thermal expansion, and volumetric coefficient of thermal expansion. Electronic properties: absorption coefficient, dielectric constant, dielectric strength, effective mass, electric hysteresis, electrical resistivity, Hall coefficient, mobility, energy bands, energy gap, energy levels, magnetic hysteresis, magnetic susceptibility, refractive index, and work function. Property groups: electron emission properties, luminescense properties, magnetoelectric properties, photoelectronic properties, piezoelectric properties, thermoelectric properties, and magnetomechanical properties.

Sources: 1. User Guide for DLA-Administered DoD Information Analysis Centers, May 1976.

2. Directory of Federally Supported Information Analysis Centers, 4th edition, National Referral Center, Library of Congress, 1979.

different mode than other presently-established DOD IACs. The present IACs operate with relatively narrow and well-defined technical charters, but the subject area of MT is extremely broad in scope. Therefore, some overlap of subject areas of common interest is expected to occur between MTIAC and current DOD IAC operations. This will be particularly evident in the "materials" area. Consequently, MTIAC operating procedures may have to be developed with the understanding that:

- Some overlapping technical interest between MTIAC and other DOD IACs is anticipated and unavoidable
- Each of the existing IACs will continue in operation, providing services and outputs in accordance with their assigned missions
- An MTIAC must develop a thorough knowledge of the scope, content, and accessibility of existing data bases as a requisite before developing its own internal data files
- Procedures must be established for access to existing external data banks and information sources, and to eliminate duplicating data collection activity and costs
- The MTIAC should serve a referral (switching center) role for MT information not in its purview, integrating existing data bases, and providing a directory of organizations and personnel available for consultation.

Among the existing IACs with greatest potential for interface with an MTIAC, the MCIC and NTIAC presently maintain data files on the DTIC UNIVAC 1100/82 computer which supports the Defense RDT&E On-Line System. Arrangements have been made to release this DLA-administered IAC bibliographic information to registered DTIC users, heretofore restricted to the contributing IAC and internal DTIC use. MTIAC, with its DOD IAC status, could be automatically certified for access to the DTIC-maintained files. Meetings would have to be held with the referenced IACs to establish the cataloging structure of the respective files and the relative volume of material on hand relevant to MT.

Consideration should be given to performing an analysis of the desirability and economic feasibility of a direct interface between IACs rather than via DTIC. It is not clear at this time, however, that the frequency of use and the value contributed by these remote files would justify the considerable expense to achieve this capability.

All the centers contacted during the study unanimously agreed that it would be feasible to provide an information interface between their centers and MTIAC. It was pointed out that the IACs already have an informal interfacing agreement and that it is technically and administratively feasible to provide more formal interactions among the centers as needed. One center, which had the most interface experience with simple referrals, exchange of newsletters, and provision of requested reports, felt that joint programs and shared data bases could also be possible.

Some of the IAC data bases can already be accessed by dial-up terminals to DTIC. One center felt that interfacing would become more feasible as electronic communication and data processing techniques are more fully developed and more generally accepted. However, one center felt that on-line interface would not be desirable with its data base, as its data output requires knowledge of its coding methods. It was also pointed out that there would be inquiries not appropriately answered by literature search and that these could be relayed by phone or letter. Computer and software specialists would have to determine requirements for terminal links with each center, and the practicality of direct phone lines for other noncomputer links would have to be evaluated if very fast responses are necessary.

Other Potential Interfaces

The results of the study also indicate that SME would be one of the professional societies with greatest potential for interfacing with an MTIAC. This finding is based on an evaluation of SME's extensive technical library, publications, and seminars, in addition to the number of respondents to the user survey who indicated SME as a source of their MT information. Most significantly, SME has indicated a willingness to make its MT information available to an MTIAC. Table C-6 in Appendix C lists SME and the other professional societies and trade organizations that may have potential for interface with MTIAC and a brief rationale for this conclusion. (Note that the list in Table C-6 is not intended to be definitive since some of the organizations not responding to the survey, as well as some not identified during this study, may also have potential for interface.)

It should be noted that many of the organizations contacted could not say definitely that they would be willing to interface with MTIAC in any form. For example, one organization indicated that such an interface would have to be examined in terms of what benefits it would have for its membership. Another stated that this interface would have to be examined and decided upon as a matter of policy.

SECTION 5
CONCEPTUAL MODEL OF AN MTIAC

INTRODUCTION

The purpose of this section is to define in broad, qualitative terms an ideal (unlimited resources) information input/output model* of a DOD MTIAC. The section includes: (1) a brief discussion of the model concept, (2) a description of the model and its major elements (i.e., sources, inputs, outputs, users), and (3) an outline of the mission, objectives, and principal activities appropriate to the MTIAC concept recommended for implementation.

MTIAC MODEL DEVELOPMENT

The approach to development of the MTIAC model was described in Section 3. After data from the user survey and existing system review were analyzed, they were structured to fit the major elements of the conceptual framework of the MTIAC model shown in Figure 3-3, Section 3. This framework outlines the parameters of concern in defining the idealized model and formed the basis for structuring alternative MTIAC concepts. In general, the MTIAC model was constructed to define in qualitative terms the following system elements:

- Prospective users of the center, by type
- The information needs of the users in terms of type of information, its forms, and response time required
- Potential sources of information, by type
- Information inflow to the center in terms of type of information, estimated volumes, and update frequencies

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*The term "model" as used in the context of this study is intended to mean a construct upon which to order in a graphic manner a concept (or a number of concepts) to permit analysis and synthesis of its constituent elements.

- The relationship between the center's inputs and outputs and the transformations required by the center's operations to produce its products and services
- The interfaces between the existing MT information system and the center.

The model was conceived as a graphic representation of these elements and their relationships. It identifies, in terms of broad categories, the entities relevant to each of the elements to facilitate systematic definition of their constituent parts. Its primary purpose is to provide an analytical technique to develop alternative concepts or functional configurations of an MTIAC based upon selection of the output products and services that best match the information needs of potential users.

MTIAC MODEL DESCRIPTION

Figure 5-1 presents the MTIAC conceptual model and its major elements. The model is structured to represent, as far as practical, the entire spectrum of potential users and the information sources inputs and outputs of an idealized (unlimited resources) center that is not constrained by the existence of other MT information resources. The figure also shows the derivation of the recommended MTIAC concept from among alternatives suggested by the model.

The discussions which follow will define each element of the model (counterclockwise, starting at the top) using the categories outlined in Figure 5-1.

Existing MT Information Resources

A major task of the study was to review and evaluate the existing information resources, i.e., where and how potential users of an MTIAC currently handle their MT information needs. Existing resources were viewed as interacting networks of information centers, data bases, and special technical libraries as shown in Figure 4-1. Section 4 identifies the major MT information resources constituting the existing system and presents conclusions based upon an evaluation of the system's effectiveness in satisfying information needs of potential users.

Basically, the existing system can be grouped into the seven components identified in Figure 5-1. Discussions of each of these components are contained in Section 4.

Information Sources and Inputs

The MTIAC conceptual model defines the center's potential sources in terms of four major categories: government, military, private,

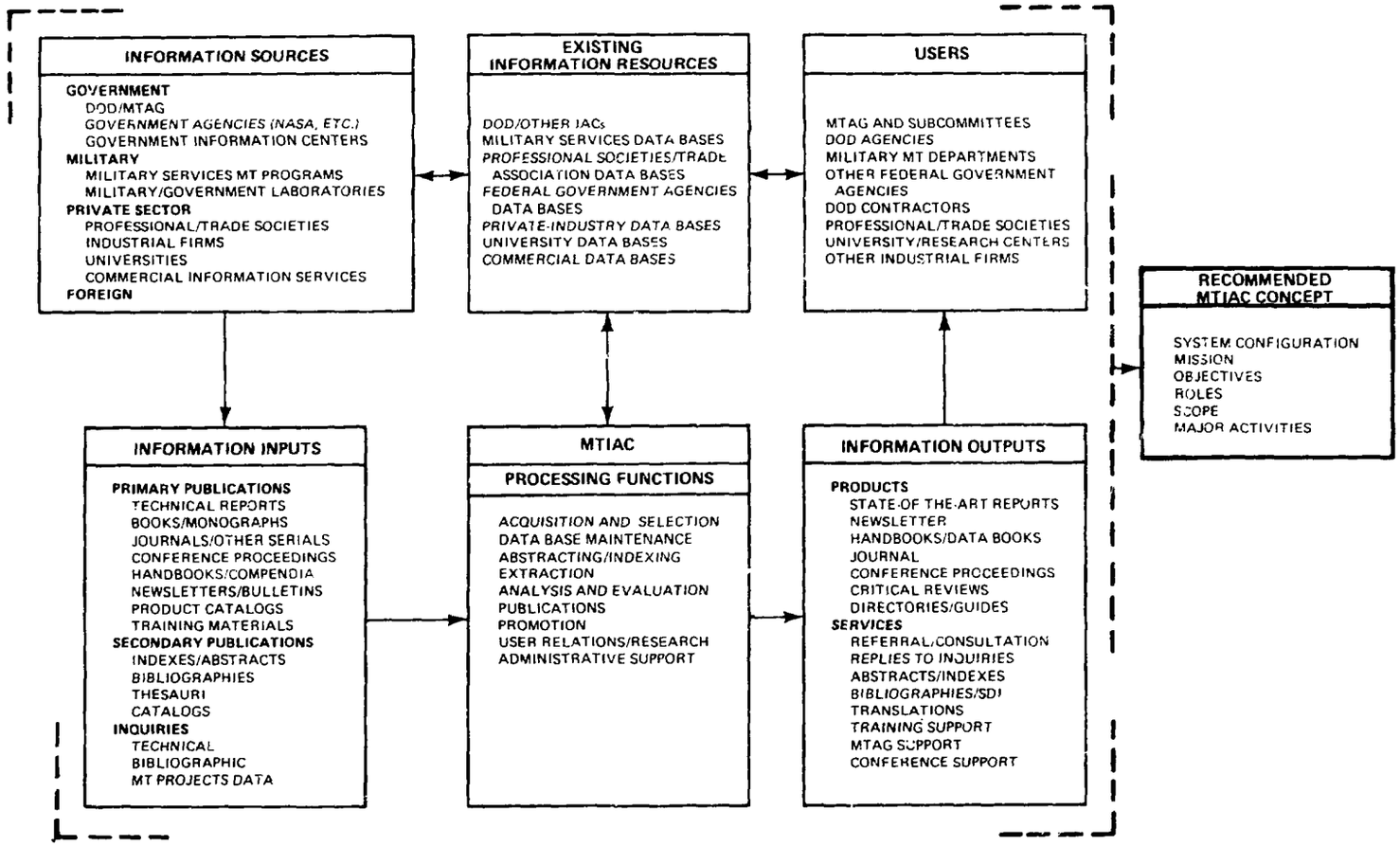

Figure 5-1. Conceptual model for an MTIAC.

and foreign as shown in Figure 5-1. Information inputs to the center are defined in the model as: primary publications, secondary publications, and inquiries. Tables C-1 through C-4 in Appendix C contain listings of the significant sources of MT information currently active as parts of the "existing system" discussed in Section 4.

An assessment of the MT information sources identified in Appendix C disclosed that many are simply not well known or understood. For example, some of the relevant data bases maintained by professional societies, such as SME, are not well know. outside their memberships. Other data bases are developed by the Federal government and may not be well publicized or accessible to potential MTIAC users. In the absence of a special guidebook or directory to MT information resources, dissemination of information about "where to look for what" while attempting to apply MT research results is, at best, hit-or-miss in most cases.

Figure 5-2 summarizes, by category, the center's potential sources of information and the types of inputs that each could most likely furnish to the center. The figure shows the breadth of the type of inputs that an MTIAC can be expected to handle once it is established and operating. Primary sources for each type of input are also indicated in the figure. These primary sources will most likely contribute the largest volume of MT information to the center during its initial data acquisition program.

The types of information inputs to an MTIAC are organized in three categories as shown in Figure 5-2. The "primary publications" category consists of published material. An assessment of a sampling of primary MT publications during the study disclosed the following shortcomings:

- It is vast in quantity
- It is diffusely distributed
- It is extremely variegated, consisting of information on every level of detail and generality
- It is uncertified--it is difficult to tell statement of fact from opinion
- It is conflicting--many versions of facts appear to exist, often in contradiction
- It is difficult to assess; given a problem requiring a solution or fact to be determined, one needs much help to find the correct writings
- Much of original research is unsummarized as to its overall meaning--thousands of discrete facts are presented with few clear summary messages.

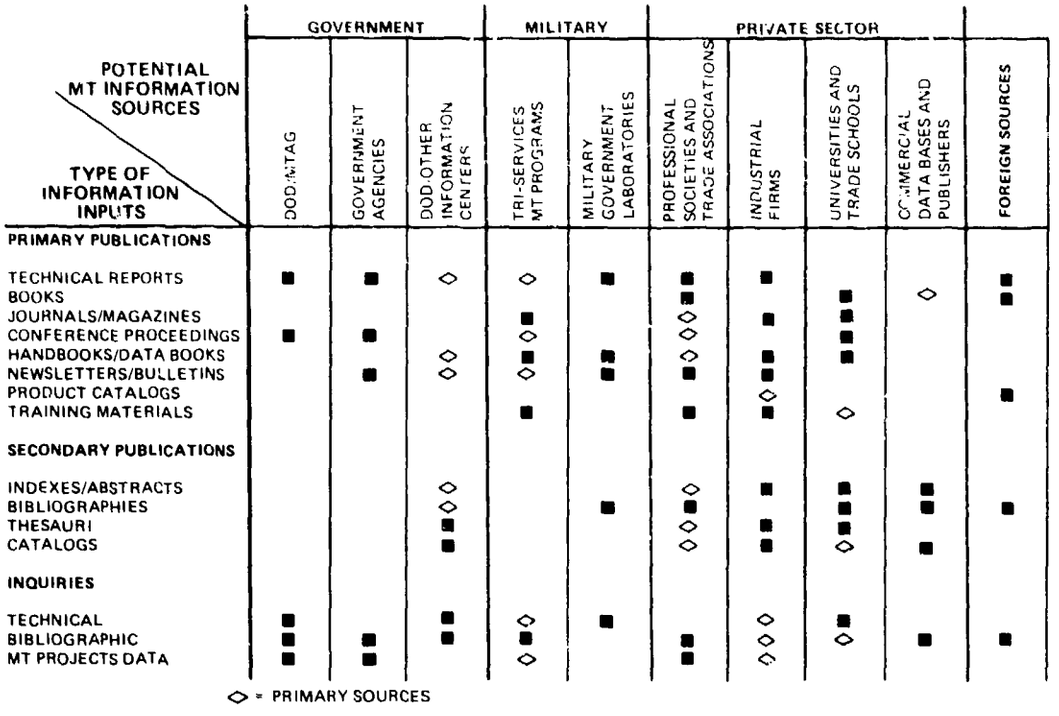

Figure 5-2. Type of information inputs from potential MTIAC sources.

The "secondary publications" were developed largely as a means for coping with and finding one's way through the primary literature. It consists of abstracts and indexes and various content guides to publications, and was largely developed to deal with the science and technology "information explosion." Billions of dollars have been spent developing secondary publications which are available in several forms:

- In abstract journals, published periodically and cumulatively in print (e.g., Chemical Abstracts, Metals Abstracts)
- On computer-searchable magnetic tapes of abstracts and indexes
- Through remote terminal Information Services (e.g., DIALOG).

In general, there are three kinds of abstract collections:

1. Discipline-oriented, such as Chemical Abstracts
2. Mission-oriented, such as NASA's collection which deals with all aspects of space technology

3. Problem-oriented, such as dealing with the effects of high temperatures and near-net shape processes.

The major existing MT collections of secondary publications are all of the first and second kind; relatively few collections of the third kind now exist. Using a combination of computer and manual searching methods, however, it is possible to glean problem-oriented collections out of the larger, more general-purpose MT collections.

Table 5-1 presents estimates of the current size and future growth of various types of MTIAC inputs. The figures listed in the table are based on estimates acquired from MT information sources queried during the review of existing information resources discussed in Section 4.

Table 5-1. Estimated volume and growth of MTIAC inputs.

Type of MT Information Inputs	Estimated Current Size	Estimated Annual Growth
Primary Publications		
Technical Reports	40,000 to 60,000	5,000 to 10,000
Books	3,000 to 5,000	~100
Journals/Other Serials	40 to 60	~4
Handbooks/Data Books	30 to 50	~6
Newsletters/Bulletins	50 to 70	~10
Product Catalogs	Unknown	Moderate
Training Materials	Unknown	Moderate
Secondary Publications		
Indexes/Abstracts	20 to 30	~12
Bibliographies	40 to 60	~24
Thesauri	Unknown	Unknown
Catalogs	10 to 20	Unknown
Inquiries		
Technical	Not Applicable	~100
Bibliographic	Not Applicable	~200
MT Projects Data	Not Applicable	~200

Technical reports resulting from completed military services MT projects and other sources will represent the largest number of inputs to an MTIAC collection. The next largest number of inputs will be technical journal articles from professional and trade societies, followed by nonproprietary technical reports from private industry and non-DOD reports from other government sources. Other IACs can be expected to contribute a moderate amount of MT-related inputs

primarily in the areas of materials and advanced materials processing. It should be noted that the technical area of materials has the greatest potential for coverage overlap with other information centers and data bases reviewed during the study.

The most significant growth in the size of the center's collection will result from technical reports produced by the DOD MT contracting program with industry and the products emanating from active MT programs in large manufacturing firms, such as General Electric, Lockheed, Hughes, etc.

Processing Functions and Outputs

The transformation of the inputs as they pass through an IAC and are reconstituted is effected by a series of processing functions as indicated in Figure 5-1. All of these functions are composite in that they consist of several operations. In total, the functions can be viewed as a set of operational steps which must be performed to provide the information outputs of the center.

Generally, the functions and outputs of IACs are similar, although they may vary in detail and in accordance with the needs of their users. Operationally, products and services of an IAC are produced by a set of processing functions that can be defined in terms of labor, equipment, and material requirements. The processing functions and the products and services for an idealized MTIAC are identified in the model in Figure 5-1. The products and services listed in the figure were selected as the most significant in terms of needs expressed by potential users of the center.

Figure 5-3 indicates the processing functions required to provide the possible products and services of an idealized MTIAC. The figure shows the major functions that must be established and operational in the center to produce each of the products and services offered to its users. For example, the products resulting from the "analysis and evaluation" function might be state-of-the-art reports, critical reviews, and technical handbooks.

The results of the survey of potential users were used to identify the information outputs that could be offered by an MTIAC to best satisfy their MT information needs. The paragraphs which follow briefly discuss the most significant of the products and services desired by potential users of an MTIAC.

STATE-OF-THE-ART REPORTS. The MTIAC should schedule one State-of-the-Art Report (SOAR) during its first year of operation and at least two during the following years. It is suggested that the initial SOAR be designed to focus attention on the emergence of new selected MT developments that are viable alternatives in fabricating

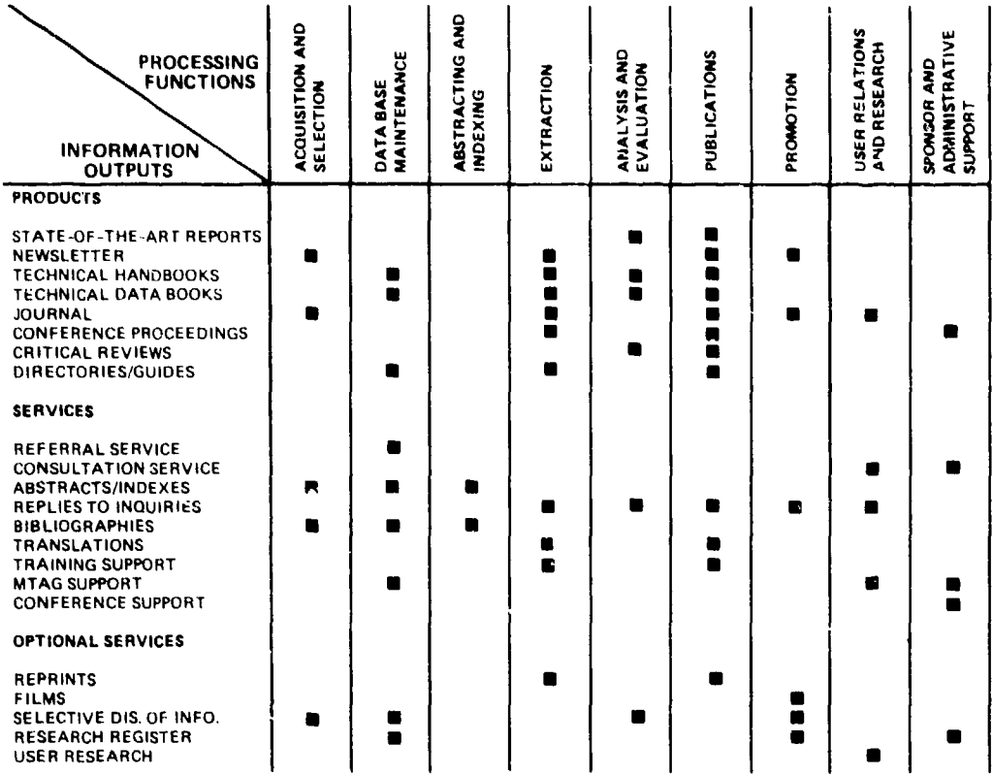

Figure 5-3. Processing functions required to produce MTIAC outputs.

military and space hardware. These SOARs should be comprehensive technology reviews of MT developments or potential MT applications. The subject area for each of these reports will be influenced by the availability of a substantial body of authoritative MT information, or may be a response to inquiries by the MT user community. Each SOAR proposed should be reviewed and approved by the center's sponsor before work is initiated.

CRITICAL REVIEWS AND TECHNOLOGY ASSESSMENTS. The technical support required for the critical reviews and technology assessments provided by existing DOD IAC operations is quite variable, since the centers are usually tailored to meet the needs of the user communities they serve. Controlling factors in the type and level of service for such studies provided by a specific center are (1) technical capabilities and size of the IAC staff, and (2) levels of funding available to the center. It is expected that such efforts will be funded by the requesting agency or user upon approval of the MTIAC sponsor.

Critical reviews and technology assessments are usually smaller efforts than SOARs. They are directed toward the evaluation and synthesis of the latest available information resulting from recent research and development findings, or comparative assessments based on the technical characteristics of a given problem. For example, a possible effort during the first year of operation could involve a review and assessment of robotics applications in a given industry.

TECHNICAL HANDBOOKS AND DATA BOOKS. It should be noted that the technical effort involved in the preparation, maintenance, and dissemination of handbooks, data books, and other standard reference documents by the MTIAC will be significant. In any IAC, handbook tasks are major technical undertakings that frequently require several years to complete. The magnitude of such tasks often justifies separate or additional funding to avoid dilution of financial resources for the other normal, less expensive types of IAC services.

ABSTRACTS AND INDEXES. The MTIAC bibliographic data base should be established on the DTIC IAC Support System during the first year of its operation. The MTIAC can then initiate an "abstracts and indexes program" similar in structure to that shown in Figure 5-4. The structure shows a number of abstracts, indexes, and other products being developed from outputs of the MTIAC portion of the DTIC data base. The three bold-line boxes represent the traditional outputs produced from the data base.

As indicated in the figure, the MTIAC should produce a number of interim and one final bound version of the MT abstracts and corresponding indexes per year after the MTIAC bibliographic data base is established on the DTIC computer.

Figure 5-4 also shows other products being generated from the MTIAC bibliographic data. These include : (1) MT Alert Bulletins which are bibliographic listings of recent acquisitions in priority areas of MT as selected by the MTAG and its subcommittees; (2) an MT thesaurus for terminology control and subject classification; (3) user interest profiles for selective dissemination of MT information; (4) MT literature bibliographies to respond to user inquiries; (5) MT Digests, or periodic abstract listings in highly specialized MT areas and new research results; and (6) MT Applications Index with specific emphasis on the applications literature to support the MT Applications Seminar Programs and other MT conferences. These products could be developed during the long-range MTIAC development program (see Section 6) after a data base of significant size has been established to support them.

TECHNICAL INQUIRIES. An important service of the MTIAC operations should be to answer technical inquiries. Such inquiries may be for technical consultation literature searches and current research

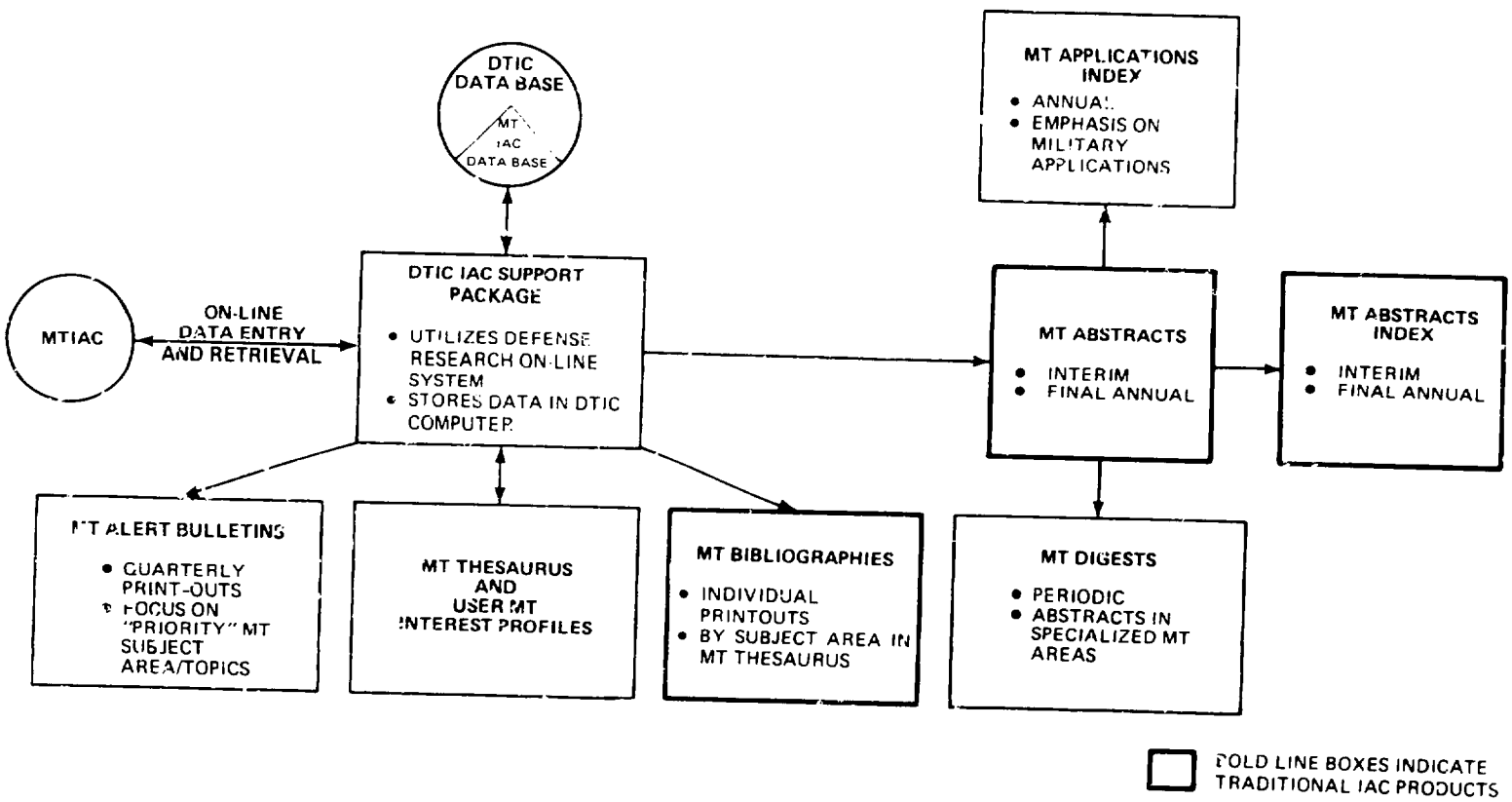

Figure 5-4. Structure for the preparation of MTIAC abstracts and indexes.

summaries. Inquiries to the MTIAC are expected to be directed by telephone, correspondence, or personal visit.

It should be the policy of the MTIAC to respond to technical inquiries by mail within 10 working days, except in those cases where users may require more immediate service via telephone or telegraph.

To satisfy periodic TAC audit requirements, as well as a need to maintain some statistical record of all technical contacts, a contact record or consultation report should be prepared for each inquiry.

BIBLIOGRAPHIC INQUIRIES. Bibliographic inquiries are expected to be the most frequent form of interaction between the MTIAC and its user communities. These will be processed as indicated in Figure 5-4. Some bibliographic inquiry services are expected to begin during the formative period of the MTIAC. Depending on the nature of the inquiry, the center, through its experience and judgment, could advise the user of the probable response time, which should normally be within 10 working days. In some instances, the desired or required response data may be specified by the user. The form of response may be by telephone, letter, memorandum or quick-look report. In every case, a record of the inquiry and response should be made and filed for audit purposes. As the MTIAC matures and current-awareness and other services start to impact the user's information search behavior, it is expected that the bibliographic inquiries will decrease.

SPECIAL STUDIES AND TASKS. An important function of the MTIAC will be to provide problem solution information to DOD, the MTAG, and other government agency users. Such tasks should be treated by the center as special studies with limited scope. Approval by the center's sponsor should be obtained before work on such studies or any additional tasks are undertaken by the center. Funding for such special studies and tasks should be the responsibility of the requesting agency.

Quick-look studies should be initiated in response to inquiries from DOD members of the MT user community. The technical effort required may typically run from a few days to a few weeks. These studies should be documented as technical memoranda, with copies distributed to principal MT program monitoring offices and to the original requestor.

Program summaries are detailed reviews of research and development programs currently in progress. Such summaries are useful in evaluating the levels of work and technical objectives of MT programs funded by DOD and other Federal agencies. Complementary studies, or potentially duplicating efforts, should be identified in such studies. The first-year technical effort should be limited to no more

than two program summaries, since much of the available staff time should be devoted to the acquisition and development of a working data base on priority MT areas.

PLANNING AND MANAGING CONFERENCES, SYMPOSIA, AND WORKSHOPS. MTIAC technical staff members should develop and maintain periodic contacts with senior investigators engaged in MT research and development work through personal visits and/or correspondence. In addition, the MTIAC should participate in and contribute to the planning of major conferences and symposia related to its specialized areas. This type of activity will allow the center to monitor the progress of active research programs and obtain information not readily available in published literature. It is especially desirable for MTIAC staff members to participate in smaller, less formalized working groups that may be established from time to time to study specific MT problems.

Potential MTIAC Users

The discussions which follow present the results of the user survey described in Section 3. The objectives of the survey were to identify the various potential MTIAC user communities and define their MT information needs, interests, and concerns. The questionnaire was designed to determine the users' opinions of the need and desirability of establishing an MTIAC, the problems they encounter in gathering MT information, the information sources they use, and the products and services they feel would best satisfy their information needs. The disciplines, interests, and concerns of each user community will be discussed, in addition to their general and specific needs in terms of information products and services. Figure 5-1 identifies the categories of potential MTIAC users considered in the survey. Appendix D contains samples of significant comments and opinions that survey respondents included in their questionnaires.

USER SURVEY RESULTS. The MT user community is very large and diffuse. The three distinct potential user groups (i.e., the sponsors/funders, MT R&D producers, and MT users) can be divided into five user communities:

1. MTAG and Military Services MT Departments
2. DOD Contractors
3. Professional/Trade Societies
4. University/Research Centers
5. Other Industrial Firms.

Table 5-2 indicates the percentage of survey responses by user community. Of a total of 700 questionnaires sent to potential users, 380 were completed and returned.

Table 5-2. Potential users survey response.

User Community	Questionnaires Received (percent)
MTAG and Military Services MT Departments	18
DOD Contractors	50
Professional/Trade Societies	3
University/Research Centers	3
Other Industrial Firms	26

MTIAC NEED. Table 5-3 displays the responses to Questions 1, 2, and 3 in the survey questionnaire (a sample questionnaire is included in Appendix A). These questions were:

1. Does a need exist for a central clearinghouse for information on manufacturing technology?
2. Should such a central facility be chartered as a DOD Manufacturing Technology Information Analysis Center?
3. a. Would you characterize yourself (or your organization) primarily as a generator, user, neither of manufacturing technology (MT) information?

   b. Would you use a central source of MT information if available to you?

INFORMATION PROBLEMS, SOURCES, AND NEEDS. The MT information problems of the five user communities, the information sources they are currently using, and the products/services chosen to best satisfy their needs are shown in Figure 5-5. The importance assigned these answers is expressed as either major or minor.

POTENTIAL USERS' BACKGROUNDS AND MT INTERESTS. Figure 5-6 shows the potential users' areas of MT interests and their educational and work backgrounds. Major areas are indicated by black blocks, minor by circles.

Brief profiles of the potential MTIAC user communities follow.

MTAG AND MILITARY SERVICES MT DEPARTMENTS. Many of the responding members of MTAG were also members of one of the military MT departments. However, as the cover letter and questionnaire sent to them were oriented toward their membership in MTAG, their answers are dominated by that viewpoint.

Table 5-3. Potential users' opinions of MTIAC's need and desirability.

Question	Response	Percent of Respondents				
		MTAG	DOD Contractors	Professional/ Trade Societies	University/ Research Centers	Other Industry
1. Need exists for MTIAC	Yes	64	88	50	70	56
	No	34	8	50	20	41
	Unsure	2	4	0	10	3
2. Should MTIAC be DOD chartered	Yes	64	70	30	70	47
	No	34	15	50	10	35
	Unsure	2	15	20	20	18
3. a. Characterize self as MT	User		83	50	20	68
	Generator		56	40	80	32
b. Would user use MTIAC	Yes		93	70	70	77
	No		2	10	20	15
	Unsure		5	20	10	8

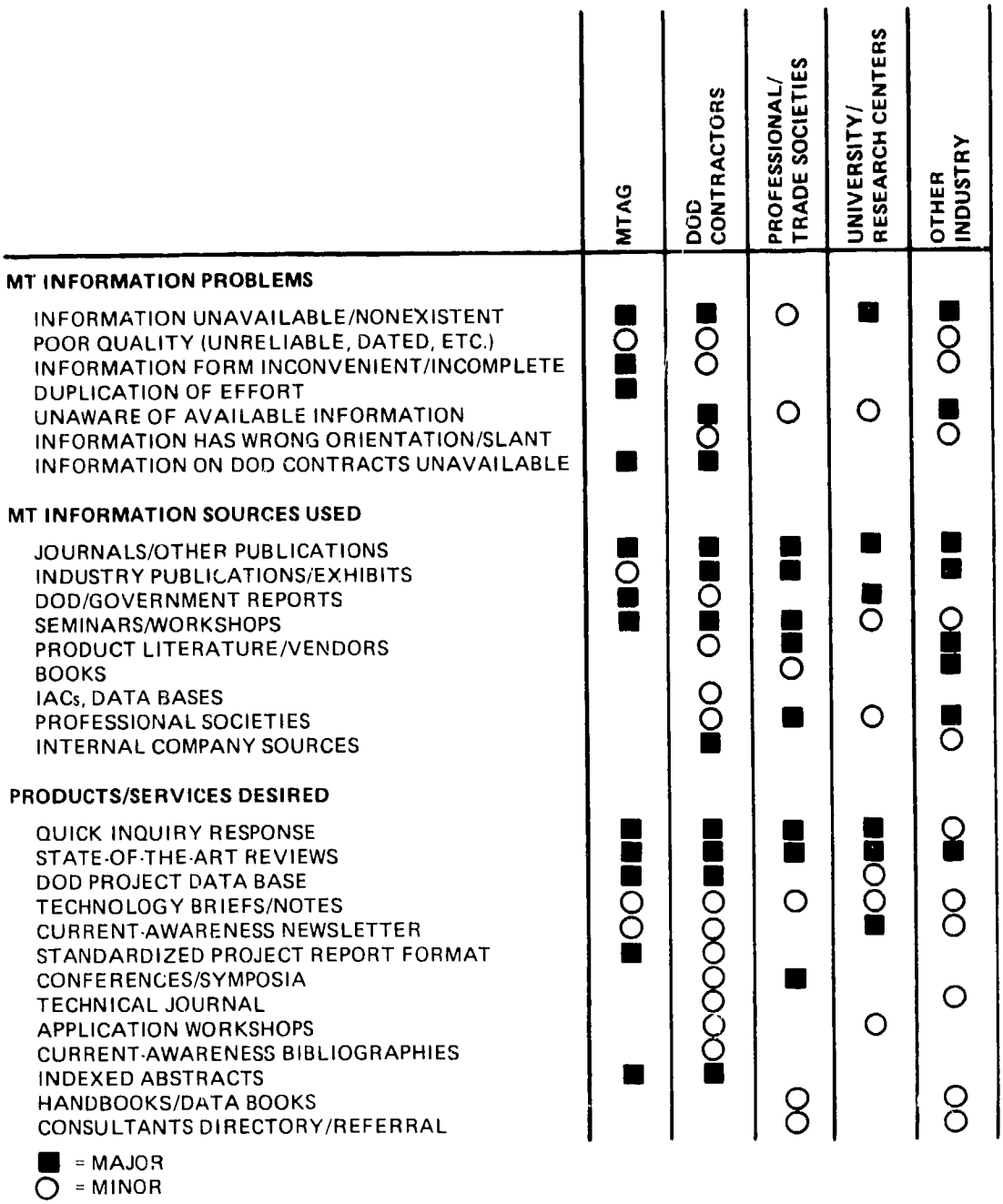

Figure 5-5. User community information problems, sources, and needs.

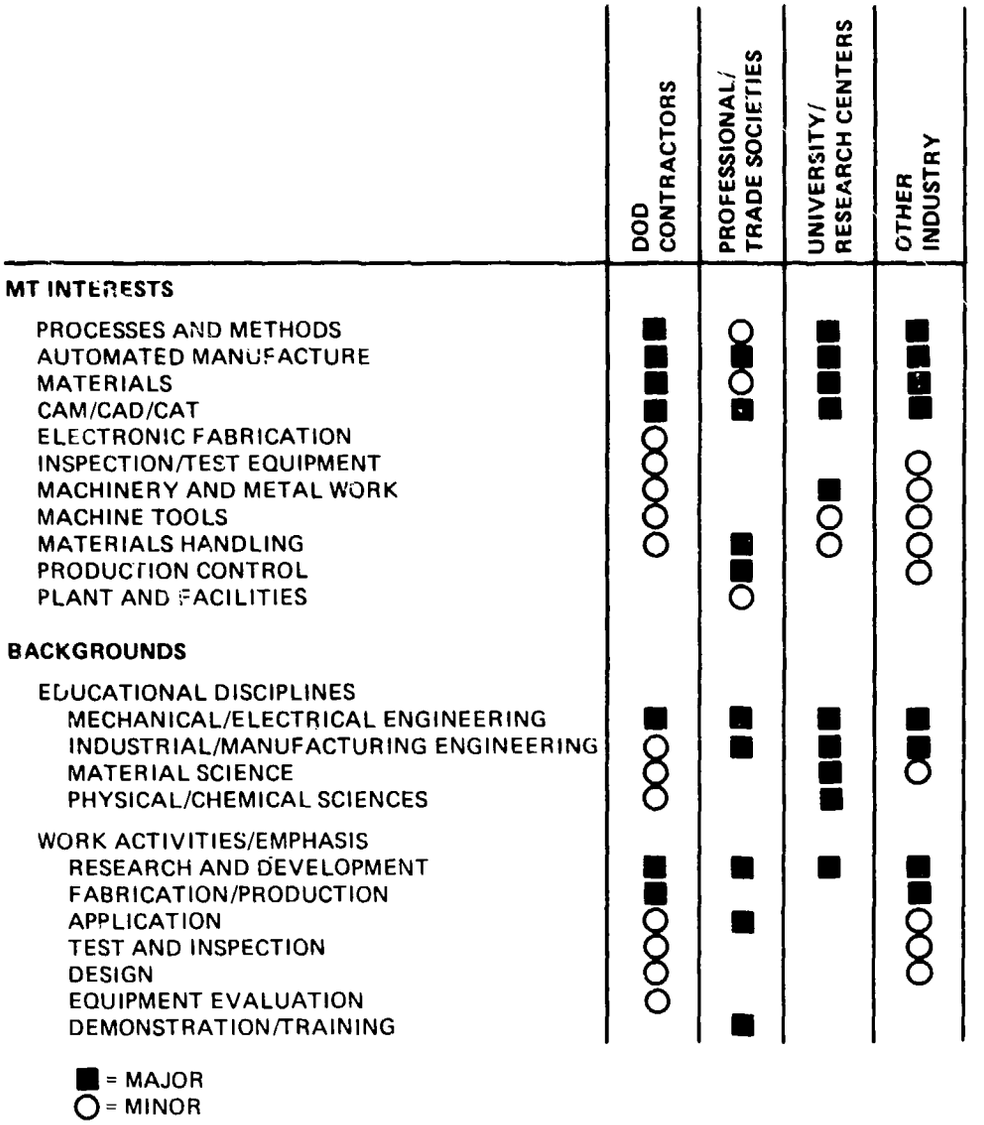

Figure 5-6. User community's backgrounds and MT interests.

As members of MTAG, these users are in the MT sponsor/funder group and have the very broad, general objective of increasing the productivity of the defense industrial base through the diffusion of MT project results. Members of an MTAG subcommittee also have the need to perform their monitoring and comparative evaluations of current and proposed government MT projects. Due to the uniformity of purpose, the data from this community were the most consistent and the relative priorities of problems and desired solutions the most certain.

The problem of avoiding duplication was repeatedly mentioned, as well as the difficulty in obtaining information on past, current, and planned DOD MT projects. Users have to exert "a massive effort" to assemble complete information and then exert further effort to condense it to an assimilable volume.

In addition to DOD/government project reports, the major sources currently used by the MTAG and Military Services community are:

- Journals/other publications
- Seminars/workshops
- Newsletters/bulletins
- Professional societies (especially SME)
- NTIS, DTIC, and other data bases.

The MT information products/services desired by this community as indicated on the questionnaires, in order of preference, were:

- Quick response to technical inquiries
- State-of-the-art reviews
- Current project status
- Technology briefs/notes
- Current-awareness newsletter.

To best serve MTAG, the MTIAC should serve as a focal point for dissemination of information on completed, ongoing, and planned DOD MT contracts, especially with regard to the relevant technology areas, their progress and results, the performing contractor(s), points of contact, and the negative as well as positive results. The information exchange between services needs to be increased with such desired MTIAC products/services as:

- A standardized computerized submission and reporting format
- Indexes of project titles, objectives, and brief paragraph abstracts
- Classification of projects as related to the interests of the primary and subsidiary subcommittees.

DOD CONTRACTORS. The DOD contractors user community had the most positive reaction to the need and desirability of establishing an MTIAC--88%--and, like the MTAG community, had a high rate of response and number of comments. The interests and concerns of this community are far more diffuse and varied than those of other potential user communities. Their needs range from the feasibility and cost

analyses needed by the manager to the complete specifications and drawings needed by the floor technician. They are in both the R&D producers and MT users groups, in a ratio of approximately 4 to 3. (Most MT "generators" characterized themselves as "users" also.) Their objectives are to improve the information diffusion to scientists, engineers, and technicians so as to produce new or improved commodities and services and increase current production using existing or modernized productive resources.

Following is a list of the MT interests, educational disciplines, and work activities of the DOD contractors:

- MT interests, in order of precedence:
  - -- Processes and methods
  - -- Automated manufacture
  - -- Materials
  - -- CAM/CAD/CAT
  - -- Electronic fabrication
  - -- Inspection and test equipment
  - -- Machinery and metal work
  - -- Machine tools
  - -- Materials handling
- Backgrounds:
  - -- Educational disciplines
    - Mechanical/electrical engineering
    - Industrial/manufacturing engineering
    - Material science
    - Physical/chemical sciences
  - -- Work activities/emphasis
    - Research and development
    - Fabrication/production
    - Application
    - Test and inspection
    - Design
    - Equipment evaluation.

The primary method of collecting MT information seems to be informal and individual. Journals and other periodicals were the most popular choice on the survey, followed by:

- Industry publications/exhibits
- Seminars/workshops
- DOD/government reports
- Product literature/vendors.

The professional societies and existing data bases or information centers are also significant sources, with the ratio of those using the societies to those using centers about 2 to 1. Of the societies, the Society of Manufacturing Engineers (SME) was the most often identified. Others were (in descending order): American Society for Metals (ASM), Institute of Electrical and Electronics Engineers (IEEE), and the American Society of Mechanical Engineers (ASME). Of the information centers, those used most by the DOD contractor community were the Machinability Data Center (MDC), the Battelle Centers (which include MCIC and MPDC), and NASA's Industrial Application Centers (IACs). Other major MT information sources of DOD contractors are the Military Services MT program offices, the DTIC and NTIS, and the internal literature collections of large firms such as General Electric, Hughes Aircraft, and Bendix.

DOD contractors share MTAG members' problems of a large volume of material hampering the search for useful information, plus the need for more detailed explanations before the technology can be transferred, promoted, and utilized for practical application. They share the need of information on DOD MT projects, not only for the results, but for the knowledge concerning the particular MT areas the government is funding and those MT projects with which other competing contractors are involved.

Negative reaction to establishment of an MTIAC by this community was primarily the belief that the need for it was being satisfied by other information systems, such as that developed at the Army's IBEA, or the planned generic technology centers to be established by the Department of Commerce, or the computerized MT projects information and data retrieval system being developed for MTAG at DOD. Some worthwhile suggestions of alternative methods for improving MT information transfer were made. For example:

> MMT information pervades so many fields that any worthwhile center would have to be large and thus costly. The money could be better spent putting terminals on the desks of potential users, terminals which would have local access to the Army's MTMIS, the USAF MASIS, DODMIS, and some sort of Navy information system.
>
> Possibly, the cross-transfer of employees between plants could be improved as an effective approach to

MT information flow. Also visits to foreign plants with advanced MT already installed.

The information products/services given priority by this community in the survey were:

- State-of-the-art reviews
- Quick response to technical inquiries
- Current-awareness newsletter
- Technology briefs/notes
- Conferences/symposia.

Appendix D contains a sampling of general technical inquiries potential users in the DOD Contractor community would ask of an MTIAC.

The survey findings revealed a strong need for information relating to reliability, feasibility, and cost of MT developments. It was also noted that the MTIAC would need to classify the information into key areas, especially those of the top four MT interests, i.e., processes and methods, automated manufacture, materials, and CAM/CAD/CAT. Speed and convenience are definitely required. Technical books were found to be far less popular, both as sources and desired products, than periodicals, briefs, or even conferences.

PROFESSIONAL/TRADE SOCIETIES AND UNIVERSITY/RESEARCH CENTERS. As both of these communities combined comprise only 6 percent of the survey response, there was little information from which to prepare comprehensive profiles. They are both MT R&D generators and, to a lesser extent, users. Both are used as sources of MT information by the other communities. The members of societies were evenly divided in their support of an MTIAC, but both communities gave strong indications they would use the center if established. The users in these communities expressed the fewest shortcomings of the existing information system, particularly the societies. As to their information needs, they gave top priority to state-of-the-art reviews and quick response to technical inquiries as information products/services an MTIAC should provide.

OTHER INDUSTRIAL FIRMS. This community has the same range and diversity as the DOD contractors and is also concerned with the diffusion of MT program results. However, their practical application of these results to nonmilitary-oriented manufacture is difficult. This community had the lowest rate of response, the smallest percentage of comments, and the least positive reaction; i.e., 56 percent felt there is a need for an MTIAC, 41 percent felt there is not, and the remaining 3 percent were unsure.

The major MT areas of interest of this community were found to be identical to those of the DOD contractors: processes and methods, automated manufacture, materials, and CAM/CAD/CAT. The primary educational background was in engineering (mechanical, electrical, industrial, or manufacturing), and the precedence of work emphasis was as follows:

- Fabrication/production
- Research and development
- Application
- Test and inspection
- Design.

If an MTIAC were to be established, 77 percent of the potential users in this community indicated they would use it. However, this is probably unrealistic, since the typical IAC user is usually not the practicing engineer, perhaps because the technical information he seeks is usually not available in sufficient depth for practical application. And, as one respondent in this community said, "Many commercial departments tend to shy away from defense-oriented sources of information." There was also feeling against government expenditure and involvement; e.g., "It would be another government agency doing what the private sector is already doing."

There is no question that the non-DOD industry community would benefit greatly from improved MT information transfer and diffusion. However, to attract this community, the MTIAC would have to organize the information so it could be utilized for nonmilitary applications. Of the products/services desired from an MTIAC, state-of-the-art reviews, quick response, and current-awareness newsletters were given highest importance by this community.

RECOMMENDED MTIAC CONCEPT

The discussions that follow present the MTIAC concept selected for implementation from among the alternative concepts derived from the model shown in Figure 5-1. The concept is defined in terms of the system configuration that best describes the center's information flow and the mission, objectives, roles, and principal activities most appropriate to an MTIAC.

System Configuration

Figure 5-7 illustrates the MTIAC as an integrated system that processes MT information for a community of users who require special products and services to achieve certain goals. Major functions of such a system are to:

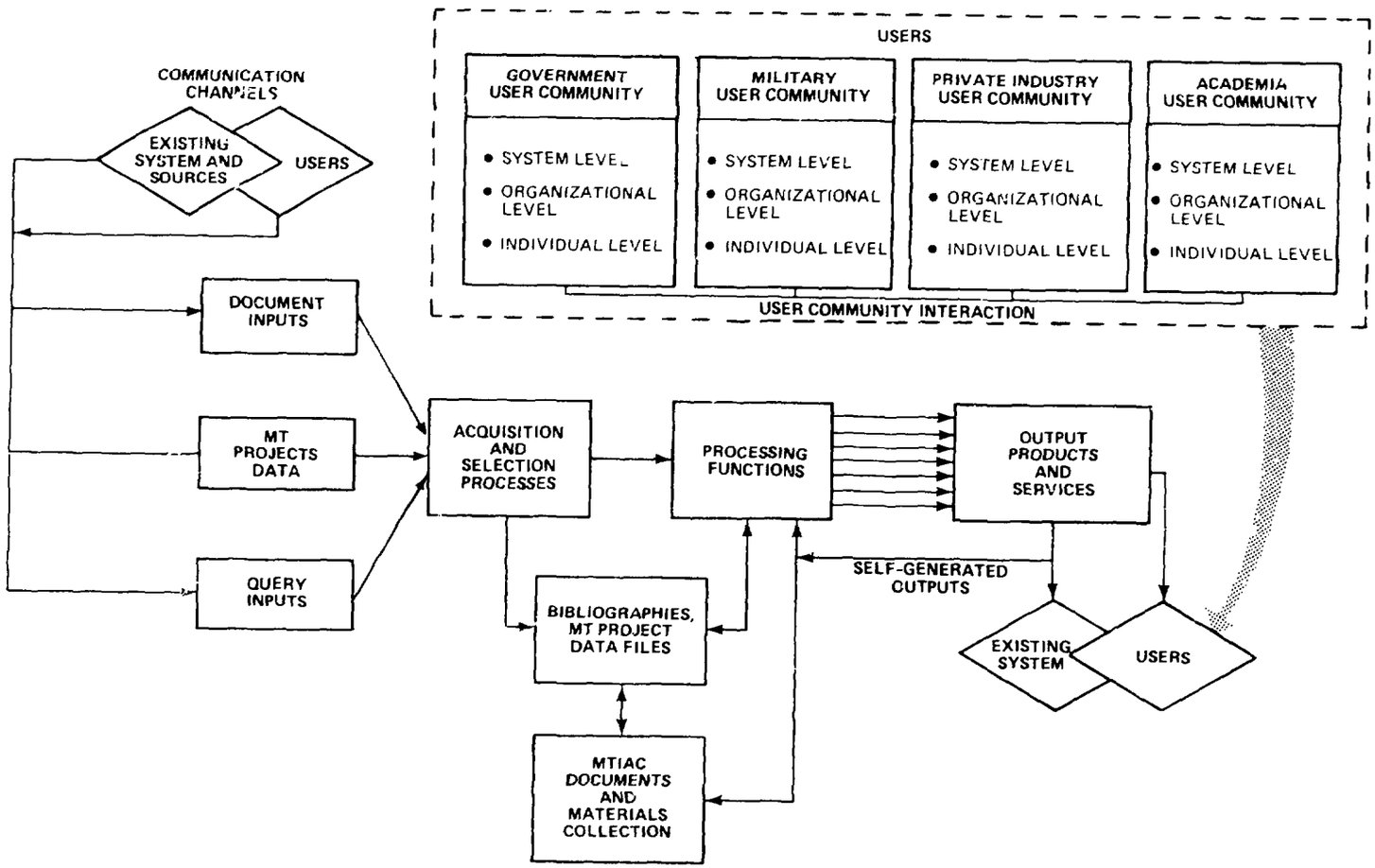

Figure 5-7. Concept of the MTIAC as an integrated information system.

1. Acquire information and data corresponding to the needs of the MT user communities
2. Extract the information elements contained in these inputs which it intends to process
3. Maintain a cumulative store of these extracted elements and selected information and data inputs
4. Disseminate information products derived from these information elements and inputs to the MT user communities
5. Provide information services of a standard or special nature on an initiative or responsive basis to satisfy the needs of users.

The system depicted in Figure 5-7 acquires three types of information inputs from various sources: documents, MT projects data, and inquiries from users and elements of the existing system. The three types of inputs are processed through an acquisition and selection function from which they undergo further (internal) processing to produce system outputs in the form of information products and services.

The system outputs, in turn, are disseminated to user communities in various sectors. At this point, the system interacts with its users on one of three levels: a "systems level," an "organizational level," or an "individual level." At the systems level, the MTIAC interacts with existing computer-based systems designed to disseminate data and secondary products (indexes, etc.) to a particular user community. At the organizational level, the system interacts with existing information centers and technical libraries operated by user organizations. On the individual level, the system services individual researchers, specialists, and other members of the MT communities on a direct basis.

The user communities, at all levels of interaction, also generate inputs to the system in the form of documents, data or inquiries which, in turn, are processed through the system. Figure 5-7 also shows the system maintaining the data files and document collection required to produce its outputs, including the self-generated outputs (catalogs, thesauri, etc.) needed to manage the collection.

In addition to viewing the MTIAC concept by its system configuration, it is prudent to define it in terms of a "charter" or other instrument that specifies the constituted authority and obligations of the system. Such a document also prescribes administrative methods to be followed routinely for the performance of designated operations and the criteria to monitor the effectiveness of the system. The

recommended mission, objectives, and activities of the center should also provide the basis for framing the system's charter.

MTIAC Mission

The mission, or charter, which DOD establishes for the MTIAC will have a major impact on the structure and focus of the center. As a minimum, the purpose of the MTIAC should be to effect higher levels of implementation and diffusion of MT program results by serving as a central source of information and focal point between defense-related industries and the Military Services. This mission could be expanded as the center matures to include other users (e.g., nondefense manufacturers) and other sources of technology (e.g., DOD mission-oriented developments related to manufacturing). Further, the center's mission could include serving as a resource to the DOD and other government agencies in areas of information collection and analysis for MT developments, and provide technical and administrative support to the DOD MTAG.

MTIAC Objectives

An important factor in planning the MTIAC was to formulate the set of objectives prescribed to it. These same objectives must constantly focus attention on the eventual aims of the center from a user's perspective. For purposes of guidance in developing a future charter for an MTIAC, the following objectives have been identified:

1. Increase manufacturing productivity of defense industrial base through technology diffusion
2. Encourage diffusion of DOD MT program results to nondefense manufacturers
3. Provide technical information analysis services relating to MT needs, development, and trends to:
   a. DOD MTAG and its committees
   b. DOD contractors/grantees
   c. Other government agencies
   d. Private industrial sector
   e. Academia
4. Increase productivity of scientists, engineers, and technicians engaged in DOD MT programs
5. Furnish technical and administrative support to DOD's MTAG and its committees and subcommittees.

MTIAC Roles

The broad mission envisioned for an MTIAC implies that it serve a role as a national unifying and coordinating agent for information activities directly or indirectly related to MT. To fulfill this role, the MTIAC must provide the competence and capabilities to: (1) identify, collect, process, store, and disseminate relevant MT information; (2) prepare or sponsor the preparation of the necessary products and services to communicate this information to users with interests and concerns in MT, and (3) coordinate and augment existing information activities to improve the transmittal of this information to interested organizations and individuals in the government, military, and the private sector.

Also implicit in the MTIAC mission is the significant role that it will play in the technology transfer process as depicted in Figure 5-8. It is anticipated that the center will serve as an important link in the network between the producers and users of MT as shown in the figure. It follows that as the center matures, it will become a crucial part of a highly developed set of technology delivery systems, serving users at all levels of requirement and sophistication.

Figure 5-8 shows that an MTIAC could function as a technology transfer agent to bring perceived or articulated user needs to the attention of sponsors, funders, and producers of research, and transmit research results and MT developments or technology in the form of information products and services to meet expressed needs of users.

MTIAC Activities

The principal activities that the MTIAC should undertake to fulfill its mission and technology transfer role are defined in the following discussions.

DATA ACQUISITION. The initial data gathering and screening activity should focus on technical areas of priority concern to DOD and MTAG. This initial effort should have three goals: (1) to produce useful information in the selected priority areas for the user community, (2) to gain experience in the needs and requirements of the user community, and (3) to consult with key MT user community contacts to devise an MT information structure and initiate the development of a thesaurus of MT terms.

The acquisition of data and documents for the center will be an ongoing activity, and "growing the data base" must be performed in an organized, effective manner. For example, the early acquisitions program should be flexible, addressing broad but related subject areas, and yet not be so broad as to dilute the effectiveness of a more specialized MT center.

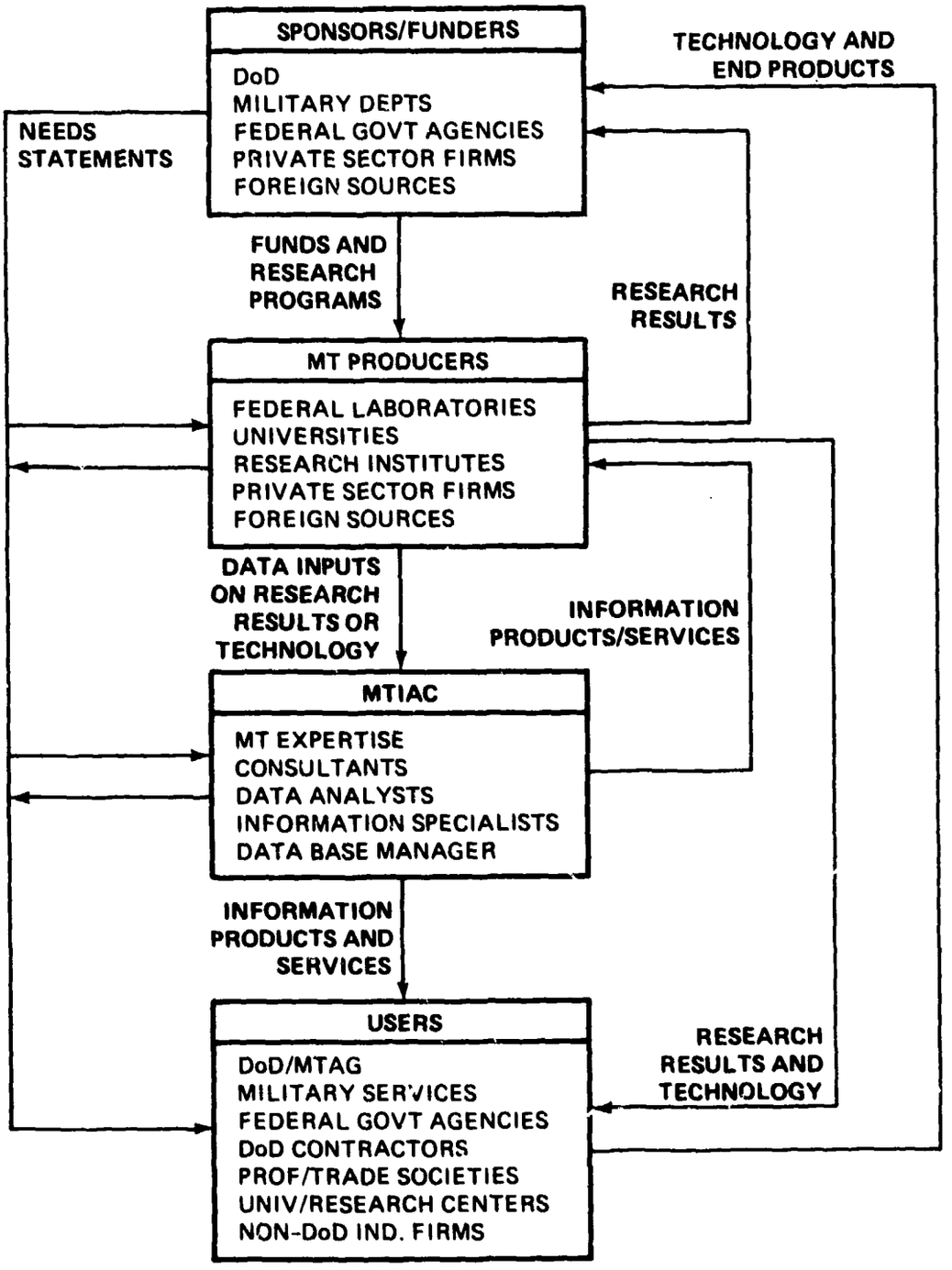

Figure 5-8. Role of the MTIAC in the MT transfer process.

The data acquisition effort should be guided by information gained by contacts with key individuals in the MT user community and in the existing system. Knowledgeable specialists should be consulted for recommendations of key data and information sources. Contacting all potential sources of information and filling specific requests for items, plus continual scanning of related publications lists, abstracting journals and announcements, should be important early responsibilities of the center's acquisitions specialist.

It should be expected that the initial data and document acquisitions will reflect many older items, but the percentage of these will gradually diminish. The flow of current items will continue to grow as:

- The MTIAC becomes better known by the user communities
- The MT research and development efforts of the government, military, and private sector expand, gathering more documents and data
- The MTIAC acquisition program becomes formalized.

Sources to be contacted for regular distribution of related technical information and data and documents to be acquired by the center were discussed previously. Preliminary listings of organizations that may serve as important information sources to the MTIAC are contained in Appendix C.

As the MTIAC proceeds toward an operational status, an aggressive data and documents acquisition program will be required. Because of the broad technical scope envisioned for the MTIAC, it would be more effective operationally to concentrate on the collection of selected (priority) data on a time-phased basis, beginning with MT data areas where user interest is the highest. This approach would be the most economical in terms of manpower required to support the data acquisition task. Any plan to carry out data collection in all MT areas may require considerably greater effort for the acquisition process, as well as the analysis and coding of material for entry into the system.

MT SUBJECTS CLASSIFICATION AND TERMINOLOGY CONTROL. Currently, there is no adequate way that the whole body of MT literature is classified by subject categories. Existing indexes tend to emphasize special areas of interest while neglecting others. Moreover, it appears that the increasing emphasis on MT applications in the private sector will have a marked effect on this quantity of literature during the next decade.

A fundamental requirement in any information analysis center is to maintain some control of terminology for both input (indexing and

cataloging) and output (retrieval) operations. Terminology control is the means of assuring meaningful answers through consistency of expression of the subject matter. Through experience, it has been found that a strict control of major information access and index terms, coupled with a modifying vocabulary, provides a very effective framework for retrieving descriptive information.

The development of an MTIAC thesaurus based on a comprehensive information structure should begin concurrently with the collection and evaluation of MT information. The thesaurus should be developed from two continually interacting classes of input. The first class is the terminology which can be isolated from existing indexes and glossaries relevant to the field of MT. The second class of terminology should be developed from the actual analysis of information collected by the center. In addition, other inputs should be used such as data collected from key users, requests for information to the center, and feedback from users and the center's sponsor.

It should be borne in mind, however, that a thesaurus must be a dynamic entity capable of responding to changes and shifts in content and emphasis, both in the information base and in terms of user needs. To be a really useful tool over time, it is expected that the MTIAC thesaurus will be in a state of continuous revision. Such a thesaurus would probably be most useful in a machinable form which can be changed and added to with ease and for which printout can be easily requested and obtained at any time. MTIAC information specialists should design the thesaurus with this advantage in mind.

The thesaurus approach to terminology control allows a completely open-ended vocabulary. No restriction is placed on the acceptance of new terms into the system. The only requirement is that new terms be edited into the vocabulary so that their semantic, generic, and viewpoint interrelationships with other terms are established.

DOCUMENT CATALOGING. Operation of the MTIAC will require cataloging and retrieval of reports and other documents. Input of this information into the data file involves cataloging (1) descriptive information (titles, report numbers, abstracts, etc.), and (2) technical subject analysis. The subject analysis should be performed by members of the center's technical staff to ensure retrieval terminology control and consistency, to keep retrieval terms up to date in terms of technical advances, and to keep the technical staff abreast of new technological developments. This will help assure a meaningful response to search requirements.

Initial data acquisition programs should be concerned with the priority technical areas of MT. Government, military, and private sources should be contacted to identify and collect all available information specifically related to the priority categories. However,

it is recommended that the data acquisition and cataloging program be as broad as possible in technical scope to avoid possible redu dant efforts as the program expands to other MT subject areas. Identification of other data bases and bodies of literature will be useful in scheduling the subsequent data collection activities. Such additional information gained will aid in developing a comprehensive subject heading structure for indexing, cataloging, and information retrieval purposes. It will also improve the planning for the eventual document storage facilities requirements for the center as the total data base is expanded over succeeding years of operation.

CURRENT-AWARENESS PROGRAM. A current-awareness program should be established during the second half of the first year of operation to automatically bring to the attention of users the currently acquired data and documents within the center's scope that coincide with their current areas of MT interest or concern. This should be in the form of an announcement bulletin of current acquisitions of the center and should be distributed to contractors, private research centers, universities, industrial organizations, and other users requiring MT information. The bulletin should be arranged by broad subject category and should contain citations with abstracts.

Activity in this area will most likely be minimal during the first year because of the limitations of the MT data base. One special current-awareness bulletin may be considered, however, as part of a promotional effort to announce the establishment of the MTIAC and to exhibit some of its eventual products and services.

The normal vehicle for the dissemination of current-awareness information is a periodic newsletter or bulletin distributed to the entire user community. The initial current-awareness program should be tailored to the priority MT interests of the DOD contractor users. The program, however, should continue to have the specific objective of keeping all users informed of new documents and data pertinent to their fields of interest. As the center matures, the newsletter or bulletin should be more general in content and suitable for distribution to all users. Typical information should include the following: synopses or critiques of newly acquired reports and journal articles, announcements or summaries of recently initiated MT programs, a conference or symposia calendar, and comments on outstanding developments and technological applications in the center's key areas of interest. As new products and services of the center become available to users, they should also be announced and described in the newsletter.

One of the major goals of the DOD MT program is the rapid communication of its results to the U.S. industrial base and other government agencies to foster wider application of technological advances. During the second year of the current-awareness program, the use of a

variety of methods currently employed to accomplish technology transfer should be given coverage in the program. Among these are:

- End-of-project demonstrations currently required of many DOD MT contracts
- Contributions to publications such as other IAC newsletters, the Army's ManTech Journal, and journals of professional societies
- Creation and selective dissemination of NTIS Tech Notes describing completed projects and suggested applications
- Annual MTAG and other MT conferences for industry, professional societies, and academia.

PROMOTIONAL PROGRAM. A promotional program should be initiated early in the MTIAC development program to publicise formal recognition of the center and to establish direct communication with the MT user community. Scheduled activities and projected action dates for the program should include the following:

	Time After Program Start
Announcement of MTIAC	45 to 60 days
MTIAC technical products and services	180 days
Special current-awareness newsletters	As needed after 6 months operation
Preparation of MTIAC brochure	4th quarter of 1st year

PUBLICATIONS. To assist in achieving the implementation and dissemination of new MT developments, the MTIAC could publish newsletters, journals, "technology opportunity bulletins," special compilations of information, and other products discussed previously under Processing Functions and Outputs.

CONFERENCES AND SYMPOSIA. The center could eventually sponsor, cosponsor, and/or conduct technical meetings on MT developments and manufacturing-related subjects of interest to its user community.

TRAINING. The center could develop and assist in the conduct of training programs on selected nontraditional manufacturing methods emanating from federally-sponsored MT developments or prepare training materials for such programs.

DATA BASE MAINTENANCE. In addition to the development and maintenance of the bibliographic data base previously discussed (see Data Acquisition), the center should undertake or assist in the following:

- Develop and/or maintain a computerized data base on relevant technology. This data base would contain information on past, ongoing, and planned MT developments.
- Develop and/or maintain a data base on MT resources. This data base, which may be computerized or manual, should contain information on relevant capabilities of DOD agencies and should include names and telephone numbers of key individuals at each agency.
- Develop and/or maintain a data base to provide inquiry services concerning the availability of relevant technological developments. An MTAIC could serve as a central focal point for government and nongovernment inquiries about past, ongoing, and planned MT developments.
- Other activities. Depending on specific circumstances, the center could also undertake special studies on MT developments and trends for the DOD, the military, and other federal agencies in areas commensurate with its capabilities.

SECTION 6
MTIAC IMPLEMENTATION AND FUTURE DEVELOPMENT

INTRODUCTION

The purpose of this section is to present the results of the analyses relevant to the implementation, startup, and future development of the MTIAC. A framework was first devised as a means to summarize and relate the various planning considerations and development factors. This framework was illustrated in Figure 3-4 and discussed in Section 3. The recommended MTIAC concept discussed in Section 5 was then used as the basis for implementation and development planning. Two development periods were considered: an initial period of 3 years and a future period beyond 3 years. A startup strategy was then structured to guide the establishment of the center and its functional scope.

For convenience of presentation, this section is divided into the following major topics:

- Implementation considerations
- Startup strategy
- Future development.

IMPLEMENTATION CONSIDERATIONS

Once the need and desirability of a DOD-sponsored MTIAC was determined, it was necessary to consider the question of feasibility. It was reasoned that, although the center was determined to be needed and desirable, it may require funding at a level far beyond that available at this time or that the broad scope of coverage may require the establishment of several centers focusing on subsets of the broad topic of MT.

The issue of feasibility was addressed primarily through the identification and evaluation of critical implementation factors that need to be considered in establishing formal information and data centers. These factors are:

- Management and operations
- Annual funding levels versus activities

- Organization and staffing requirements
- Workload and volume projections
- Facility and related requirements.

The impact of these factors in implementing the MTIAC concept is outlined in the following discussions.

Management and Operations

There are presently representative IACs operating in each management mode specified for consideration in the study contract, viz, Office of Secretary of Defense (OSD) and Services. Operations responsibilities are typically assigned to the Services or DOD contractors. Several centers, like PLASTEC and SVIC, operate within DOD facilities such as Picatinny Arsenal or the Naval Research Center (NRC). There is a large group of specialized Army-sponsored centers which operate in Army laboratories such as the Army Waterways Experiment Station (WES). Other DOD IACs are contractor-operated. The existing DLA-managed centers generally operate with OSD funds, augmented by reimbursement funds derived from a user charge or cost recovery program. If DOD proceeds with plans to establish the MTIAC, funding responsibility will most likely rest with DLA.

Table 6-1 matches the functions of the MTIAC with the recommended funding sources, the management and operations responsibilities, and the estimated availability of services over three time frames. The division of funds for all functions as shown in the figure should be shared by the Military Services at 90 percent and the OSD at 10 percent. This was deemed to be an equitable sharing based upon the extent of the benefits that each of these funding sources could derive from the center.

Management and operations of the center's primary functions were also determined to be as listed in Table 6-1, with OSD shown as developing and maintaining a DOD MT projects data base with an on-line terminal link to the center. Also indicated is the use by the contractor of the DTIC support system and data base for bibliographic data to support the center's document collection. Most of the other functions shown (with the exception of "conference sponsorship" and "EOP demonstrations") were evaluated as most feasible for management and operation by a contractor firm.

The recommended time table for offering the products and services generated by the center's functions is indicated in the "Availability to Users" column in Table 6-1. Priority activities required to establish the center as an effective and responsive system are also identified. It should be noted, however, that the recommended activities as a group in any of the time frames do not necessarily correspond to any particular funding level.

Table 6-1. MTIAC functions versus source of funds, management responsibility, and availability.

MTIAC Functions and Activities	Source of Funds		Management/Operations			Availability to Users		
	OSD (percent)	Military Services (percent)	OSD	Military Services	Contractor	1st Year	2nd/3rd Year	Beyond 3rd Year
Data Base Maintenance	10	90						
Bibliographic File					(DTIC)	(X)	(X)	X
DOD MT Projects			X				(X)	X
Document Collection					X	(X)	X	X
Inquiry Services	10	90			X			
Technical						(X)	X	X
Referral						(X)	X	X
MT Projects Data							(X)	X
Current Awareness	10	90						
Newsletter					X	(X)	X	X
Bibliographies					X	X	X	X
SDI Service					X			X
Publications	10	90						
State-of-the-Art Reports					X	(X)	X	X
Handbooks/Data Books					X		X	X
Critical Reviews					X	X	X	X
Technical Journal				X	X		X	X
Technology Notes					X		(X)	X
MT Resources Guide					X		X	X
Special Studies					X			X
Conferences/Symposia, etc.	10	90		X	X			
Sponsor Support					X		X	X
Proceedings					X	X	X	X
MTAG Support	10	90		X	X	(X)	X	X
Training Support	10	90						
EOP Demonstrations				X		X	X	X
Media Materials					X			X

(X) = priority activity

Annual Funding Levels Versus MTIAC Activities

Annual funding levels of interest in the study were:

- $400K to $700K
- $700K to $1000K
- In excess of $1000K.

The level of available funding will obviously govern the staffing level of the MTIAC and will therefore affect the type of volume of technical services the center will be able to provide to its user community. An FY75 audit of DOD IAC operations by the Assistant Secretary of Defense, Comptroller's Office, provided the data relevant to the staffing and funding levels of centers active at that date. The DLA also furnished FY79 data for all operational centers for evaluation during the planning study. These data are summarized in Appendix E. While it is known that substantial inflation has occurred between FY75 and FY79, information from annual reports of various DLA-administered centers suggests that operating budgets over the past 4 years have not risen at the same rate of inflation. Experience indicates that some centers with relatively constant budgets are experiencing a compression of available labor hours due to increasing labor costs.

For example, Annual Direct Funding for nine DLA-administered IACs in FY75 ranged from $139,000 to $791,000 corresponding to staffs of 8 to 21 personnel. In contrast, by FY79 Annual Direct Funding for the same number of IACs ranged from $162,000 to $784,000 for staffs ranging from 6 to 18 personnel.

Since all established DOD IACs operate within the broad guidelines of DOD Instruction 5100.45, it is not coincidental that these centers provide similar services and outputs. There are differences, however, in the amount of resources (labor and funds) allocated by each center to particular functions, reflecting the priorities and needs of its user community. An estimate of the percentage of effort allocated to typical IAC activities (as defined by COSATI) versus various annual funding levels is shown below:

	Funding Level		
Activity	$400K (percent)	$700K (percent)	$1000K (percent)
Input	35	30	25
Acquisition, cataloging			
Technical discussions with investigator(s)			
Visits			
Meetings			

Activity (continued)	Funding Level (continued) $400K (percent)	$700K (percent)	$1000K (percent)
Processing Technical abstracts Critical reviews State-of-the-art reports (SOARs) Handbooks Special analysis projects Monographs	45	50	60
Output Bibliographies Reports Technical inquiries Visitor consultation	20	20	15

It should be noted that these estimates are based on the experience of one IAC (DASIAC) and correspond to operating and performance data supplied during audits by OSD in FY75 and GAO in FY78. It is highly probable that these percentages will vary somewhat for an MTIAC. One variable is the maturity of the IAC. Seasoned IACs will have established data bases and the annual monies devoted to routine acquisition, cataloging, and file maintenance will level off at a constant rate after about the first 5 years of operation. (This presumes that circumstances do not require a continual expansion in technical scope.)

Another variable is the amount of time devoted to in-depth analysis of state-of-the-art studies. A new center spends a considerable amount of time acquiring and organizing a suitable data base and the center may not have a data base that has the capability for the center to undertake more than two comprehensive studies per year. As the data base expands, the IAC would be in a position to undertake an increasing number of studies on a broader range of topics. The level of funding available to the MTIAC startup program will influence the number of personnel contributing directly to the program and, therefore, the number of simultaneous tasks that can be performed at a given time.

Thus, available annual funding is a critical factor. Any sharp change in annual budget will directly affect the number of staff members assigned to the IAC. Staffing levels in turn determine to a large degree the number of projects that can be carried out simultaneously throughout the contract performance period. The use of a large number of part-time staff members or consultants is a highly desirable mode of operation, particularly if the IAC supports a very broad field of technology. The real criterion is the total manhours or manyears provided at a specified level of contract funding.

In most cases, DOD funds represent only a portion of the revenues available to the centers; most IACs receive a significant level of financial support from non-DOD users. Generally, the DOD encourages a center to develop, over the long term, other funding sources, through a cost recovery program, equivalent to approximately 50 percent of total revenues of the center. Such a program and its impacts on an MTIAC are discussed later in this section under Future Development.

Annual funding levels for the MTIAC were evaluated using three alternative activity service levels as noted in Table 6-2. Estimated costs for the activities relevant to each primary function were determined for each service level. Critical IAC activities and those expressed as priority needs by potential users were emphasized, particularly in the baseline level. The activities and cost factors were then summarized and matched to the appropriate funding levels. Table 6-2 shows that the most sophisticated center concept, Service Level C, corresponding to annual funding of "over one million dollars," includes some labor-intensive activities in addition to all of the activities identified in the other two service levels. It is estimated that it would take an MTIAC about 5 to 6 years to achieve the service level for this sophisticated concept. Annual reports of existing IACs and personal discussions with IAC directors were used to derive the service levels corresponding to the annual funding levels in Table 6-2. Costs and other data used for comparative evaluation of IAC service and funding levels are contained in Appendix E.

It is recommended that DOD encourage the MTIAC to seek sources of revenues from its private sector users. Initially, DOD funding should represent 80 to 100 percent of the center's funds. It is estimated, however, that the MTIAC should have little difficulty in increasing user revenues over several years until they equal the DOD funding level.

Recognizing that the level of funding will depend highly on budgetary constraints, it is recommended that the initial annual DOD funding for the MTIAC be in the range of $400,000 to $700,000. Anything less than this amount would severely limit the center's capabilities in light of the startup effort required.

Organization and Staffing Requirements

ORGANIZATIONAL PHILOSOPHY. Existing DOD-sponsored IACs represent a mixture of staffing types. Although most centers are operated by nongovernment organizations, some, such as PLASTEC, are staffed with Civil Service employees. Obviously, there are advantages and disadvantages to each type of staffing. Civil Service employees provide lower costs for operating the center, greater control of the handling of sensitive program information, greater management involvement on

the part of DOD and the Services, and, possibly, easier access to proprietary defense contractor information. The disadvantages of Civil Service staffing include some loss of control over individuals assigned to the center and less flexibility to easily modify staffing levels due to funding variations.

Table 6-2. Annual funding levels and activities.

A $400 to $700K (baseline service level)	B $700 to $1000K (includes all activities in Service Level A plus those below)	C $1000K Plus (includes all activities in A and B plus those below)
MTAG/Support		
Data Base Maintenance -Bibliographic File (DTIC Support) -Document Collection	-DOD MT Projects Data[a] (OSD Support)	-MT Resources File
Publications -State-of-the-Art Reports -Critical Reviews	-Handbooks/Data Books -Technical Journal -MT Resources Guide	-Technology Notes -Special Studies
Conferences/Symposia -Proceedings	-Sponsor/Management Support -Application Workshop	
Training Support -EOP Demonstrations, Promotion	-Film Collection	-Media Materials -Short Courses
Inquiry Services -Technical -Referral	-DOD MT Projects Data[a]	-MT Expertise/ Capabilities
Current Awareness -Newsletter -Bibliographies		-SDI Services

[a]Can be initiated under Service Level A and completed under Service Level B.

In balance, it is recommended that the center be staffed and operated by a nongovernment organization. Such an organization could be a private corporation or a nonprofit institution or organization. The center could represent either part or all of the organization's business operations. There are a number of organizations in the private sector that would have the capability to establish and operate an MTIAC for the DOD. Therefore, it is recommended that DLA continue its plans for a competitive procurement to be used in determining the most suitable contractor for establishing and operating an MTIAC.

DOD SPONSORING AGENCY. Sponsorship of an IAC is usually assigned to a specific DOD agency serving as a "monitor/sponsor." This agency normally provides technical, managerial, and contractual direction to the IACs.

Although numerous DOD agencies could manage the MTIAC, the most suitable organization, in terms of its current missions and functions, appears to be the Army Materials and Mechanics Research Center (AMMRC). This organization already manages several DOD centers (e.g., the MCIC and MPDC), is actively involved in the management of the Army MT program, and is responsible for dissemination of MT program information. Further, AMMRC has managed numerous cost driver studies, publishes a technical journal on MT, and has the requisite technical and managerial expertise to oversee the functions of an MTIAC. Other agencies that may qualify for consideration include the Army Industrial Base Engineering Agency (IBEA) and the Air Force Materials Laboratory (AFML).

No matter what agency is selected to manage the MTIAC, it should be clearly communicated that the center, once established, must work closely with all relevant DOD and Military Service organizations.

MTIAC ORGANIZATIONAL STRUCTURE. In the first phase of implementation, a center should be established which can be responsive to the priority requirements of potential users discussed earlier. However, although the MTIAC alone must assume full responsibility for accomplishing its mission and objectives, in order to be effective, it must develop cooperative relations with information activities of other organizations within the DOD and other government agencies, as well as from the private sector.

The recommended organization for the initial operating phase of the MTIAC shown in Figure 6-1 consists of four line branches: Referral Services, Acquisition, Technical Processing, and Technical Staff. A Management Services group, reporting to the MTIAC Director, is included as a staff position.

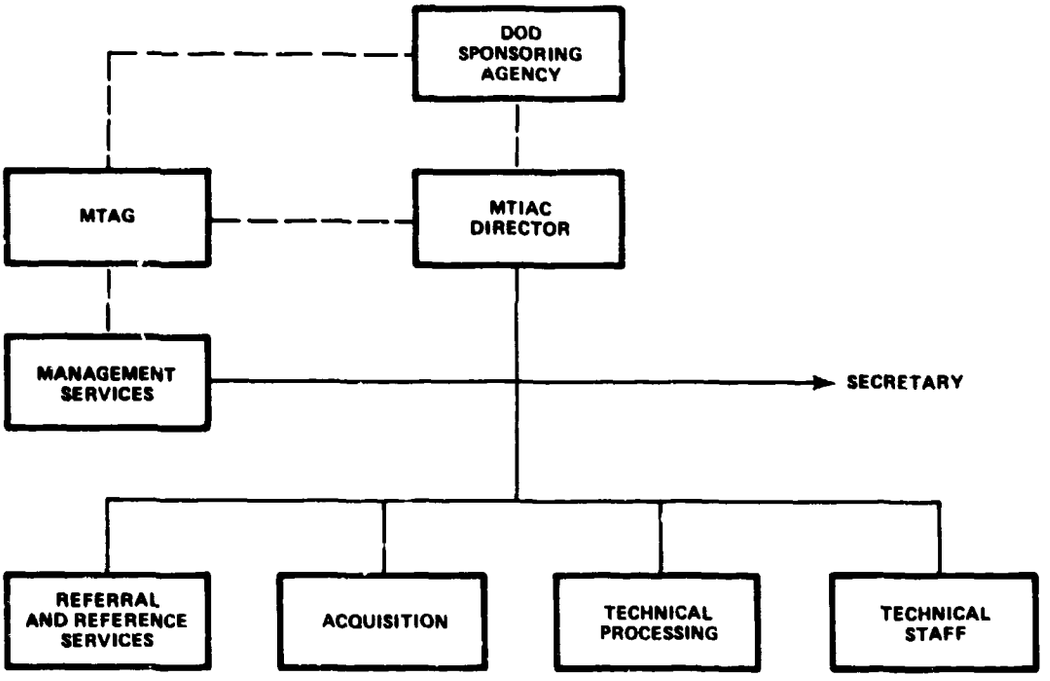

Figure 6-1. Recommended organizational structure for the MTIAC.

The Management Services group should coordinate the management information system and contract control, and work on systems and procedures for the MTIAC. Other duties would include intergovernmental relations such as coordination with the MTAG and its committees, DLA-administered IACs, and information centers of other federal agencies; ensuring a smooth flow of information between MTIAC and these other agencies; and maintaining working relationships with DTIC, NTIS, and other documentation services.

A staff of technical personnel (i.e., manufacturing engineers/advisors) should be employed in the analysis of information which is part of the MTIAC collection and in the rewriting and synthesis of this information into language suitable for various user groups. The practical application of MT research and development to everyday problems, the utilization of technology by private industry, the results of scientific analysis summarized in SOARs--all can be of lasting value to the various user communities served by the MTIAC. The scientists and engineers with MT interests in these communities are in a unique position, toward the "middle of the information pyramid" where diverse data are available for study and for intelligent analysis.

INITIAL STAFFING REQUIREMENTS. Table 6-3 lists recommended initial staffing for the MTIAC. Certain assumptions have been made as to workload volumes (i.e., processing 50 items/day) that must vary as the program expands or changes. The professional personnel and much of the clerical personnel should be able to perform more than one task. The resulting overlap training will allow for variations in the information flow.

Table 6-3. Recommended initial staffing for the MTIAC.

Position	Organization Group
Director	Center Management
Senior Technical Advisors (2)	Technical Staff
Manufacturing Engineers (2)	Technical Staff
Senior Information Scientist	Technical Processing
Computer Programmer	Technical Processing
Technical Editor	Technical Processing
Referral/Reference Specialist	Referral Services
Librarian	Acquisition
Secretaries (1 Junior, 1 Senior)	Technical Staff Center Management
Keypunch Operator	Acquisition
Business Manager/Special Affairs Coordinator	Management Services

The staffing recommendations assume that the computer programming and all data processing personnel are not necessarily part of the center itself. The overall systems design will dictate record length, method of input (i.e., hardware available) and, therefore, the number of input processors required--keypunchers, typists, etc. It is also assumed that graphic design and reproduction work, except for standard office-copying type activities, will initially be provided as support to the MTIAC.

Workload and Volume Projections

Workloads of the MTIAC will depend primarily on the number of items (documents and materials) and queries handled by the system. The depth of indexing and input requirements, the complexity of the queries, and the speed of response requirements are major contributing factors to workloads. An exception to these considerations is the Technical Staff for preparing materials, whose workloads will be regulated by the center's overall management plan for output.

The following are workload and volume estimates for each group of the recommended organization.

ACQUISITIONS. Experience with IAC acquisitions indicates that acquisition volume for specialized collections is relatively constant and, therefore, manpower requirements are also relatively constant. As initial acquisition of older items--back issues of journals, etc.--for a data base and reference collection begins to diminish, the flow of current items into the information center begins to increase as a result of the producers of information becoming aware of the center and its requirements for information.

The volume of information available to the MTIAC depends directly upon the number of active MT project investigators and, therefore, the level of funding of related MT programs. From both General Electric and DOD experience, as well as examination of other information organizations during the study, it was estimated that the average MT investigator produces at least one report per year.

It was estimated in the study that there were approximately 50,000 to 80,000 items in the MT information base. This base accumulated over a 15-year period. Therefore, between 3000 and 5000 documents per year will have been produced prior to the formation of the MTIAC. The annual volume of current items will certainly not fall below this figure because of the additional emphasis being placed on MT development in DOD, the Military Services, and the DOD-contractor community. However, estimates of workload have been made on the basis of 50 items per day or 12,000 items per year.

Although 1982 may not see 12,000 new items entered into the MTIAC collection, findings based on previous studies indicate that by 1990, at least that many items will be added. The acquisition to the system of a selected portion of the present 50,000- to 80,000-item data base will help keep workloads constant for the initial startup period.

TECHNICAL PROCESSING. The processing time of each item will depend upon the design of the input form, the level and experience of personnel doing the work, the depth of indexing required by MTIAC, and other similar factors. Past studies, however, have provided time estimates of 36 to 58 minutes per item with an average of 45 minutes per item. The intellectual effort of identifying, cataloging, indexing and abstracting, and physical processing were included. A reasonable projection is that each professional can prepare an average of 10 documents per day as input to the system.

REFERRAL AND REFERENCE. Workloads in this area depend upon a series of interacting variables. The success of the center to one degree is measured by the growth rate of referrals and requests for

materials and reference service. As the center becomes better known and is better able to react efficiently and competently, this workload will increase. At the same time, a learning curve is evident. In all center operations there are stock inquiries which may be adequately treated by stock responses. This learning curve is enhanced by the introduction of query response into the basic information file. The experience of other mature centers has indicated the ability of a few people to handle a very large volume of referral and reference demands.

TECHNICAL STAFF. The technical staff should consist of subject-oriented specialists in the field of key MT areas. They must be responsive to the special information needs of DOD, the MTAG and its committee components, the center itself, and all classes of outside users.

During its initial implementation period, the technical staff should give consideration to producing or contracting a series of SOARs directed to the MT development community, covering priority areas of MT.

Facility and Related Requirements

Consideration should be given in the initial implementation period to the allocation of adequate floor space to offices, conference and storage rooms, and to required work areas in the physical plant of the MTIAC. Table 6-4 delineates the minimum floor space allocation suggested for MTIAC initial startup based on the assumptions that each manager should have a minimum of 120 to 150 square feet, each professional an average of 100 square feet, and each clerical employee an average of 80 square feet. Additional floor space is required for work tables, conference areas, reproduction equipment, document storage, record files, and reading rooms. The General Services Administration (GSA) issues data pertinent to the minimum requirements of floor space in government facilities. Such guides should be consulted before developing the MTIAC facilities plan.

Most information centers tend to outgrow their physical facilities much sooner than expected and, therefore, careful planning should go into the development of the facilities plan. This applies especially to those floor space areas sensitive to the growth of the collection in hard copy and bibliographic file forms, and to the document (hard copy) storage and clerical work areas.

Because of the necessity to store hard copies of the MT report literature, a major task of formulating the facilities plan is to design an adequate storage area. Careful consideration should also be given to the design of a storage vault or temperature-controlled storage area for storing and safekeeping of films, magnetic tapes, and other temperature-sensitive materials.

Table 6-4. Suggested minimum floor space allocations for initial MTIAC facilities.

Square Footage of Physical Elements (offices, rooms, areas, etc.)	Floor Space Allocation (square feet)
Managerial (5 x 150) offices	750
Professional (14 x 100) offices	1,400
Clerical (9 x 80) areas	720
Work space and reproduction equipment (10 x 80) rooms	800
Conference area (12 x 15) or room(s)	180
Reading room (30 x 40 room including shelves, tables, etc.)	1,200
Storage area (30 x 70 room with densely-spaced vertical shelving)	2,100
	7,150
20 percent additional floor space to provide for hallways, expansion, etc.	1,430
Total floor space	8,580[a]

[a]Approximately 300 square feet per staff member.

The important design parameters which should be considered in development of the facilities plan for the MTIAC are:

1. The site, the containing building, and the floor(s) assigned to house the center
2. Availability and compatibility of utility services
3. Plans for moving to future sites, buildings, etc.
4. Funding available and budgetary constraints
5. Users being served and in-house traffic
   a. Number and type of individuals to be served at the facility
   b. Number and type of organizations comprising community at large

c. Range of interests, concerns, disciplines, subject areas

6. Information functions and operations

   a. Document collection size and growth

   b. Information services and products

   c. Information specialists for special services.

STARTUP STRATEGY

Phased-Development Approach

Because of the wide variety of activities the MTIAC could undertake and the diverse number of approaches that could be taken, it is important to carefully develop the center's startup strategy. The sequence and priorities of startup activities, as well as the scope of services offered, should be important elements in implementing an MTIAC.

The existing system review (Section 4) provided an insight into the breadth and diversity of MT as it applies to producing and maintaining DOD materiel. It became obvious early in the study that to keep the technical scope of the center within manageable dimensions, a "phased-development" approach would be needed. It was felt that such an approach would decrease the risk of the center expending resources outside of its capabilities during its formative period of development.

Although the actual startup strategy will eventually be determined by the organization operating the center in conjunction with the DOD managing element, the phased-development approach may be the most appropriate so that the MTIAC could initially focus on developing the data bases, designing publications, and emphasizing diffusion of completed DOD MT project results. Further, the center could limit its in-depth technical expertise to only several technology categories, although the center staff may eventually be conversant in all areas of MT. Later, the center could be expanded to encompass more technology areas of expertise and could focus on diffusion of ongoing and planned projects, as well as becoming more actively involved as a resource to the DOD.

The final startup strategy should be structured in a manner that allows the center to show positive benefits for each activity. For example, by initially focusing on the dissemination of completed project results, the center could quickly demonstrate its value as a technology transfer agent.

Near-Term Emphasis

Realistically, it will require several years for an MTIAC to reach the desired level of effectiveness and capabilities. Data bases must be developed and implemented. Publications must be designed and launched. Communication channels must be established with DOD elements, and a user base must be developed. These activities alone could probably take a minimum of 2 years.

Establishment of the center was defined for purposes of this study in terms of a startup strategy and its near-term operations. Ten planning elements, as shown in Table 6-5, were considered. Each element was examined with respect to a near-term and future emphasis. The startup strategy was then developed to correspond to the near-term emphasis and the lowest feasible annual funding level in keeping with a phased-development approach.

This approach is based on an emphasis in the near-term of a few selected MT areas such as the candidates outlined in Table 6-5. The criteria for this near-term scope would be to initially focus on dissemination of completed MT project results (which, incidentally, could help in quickly demonstrating the center's value as a technology transfer agent). Identifying areas of overlap and avoiding duplication of coverage with other DOD centers would also be emphasized in the near term. MT coverage would concentrate on pervasive areas that cut across the widest possible spectrum of DOD materiel and that are demonstrated as highly beneficial and cost effective within short turnaround.

In its formative development years, the center could be expanded conservatively to encompass other MT key areas and could start providing data concerning ongoing and planned MT projects, as well as manage the production of more publications and other products and services.

Initial Data Base Development

To make the initial development of the MTIAC most effective, advantage must be taken of the most advanced techniques available to develop the MTIAC data base consistent with an economic and orderly implementation. The application of data processing and computer techniques to information center operations can result in significant economic savings as well as enhancing the scope of services provided. In spite of this, many centers large enough to warrant the investment in computer techniques usually find themselves restrained by their large investment in traditional routines and records.

The cost of computer techniques cannot be justified in a mechanized system solely in terms of bibliographic search or information retrieval. This is especially evident when the total file is small

and easily maintained manually. However, if retrieval can be combined with other system needs, the use of computer techniques results in significant savings. Within the MTIAC, the production of a variety of byproducts from the computer-based file as well as the provision of flexibility for future expansion can be used to justify computer techniques from the center's inception. The fact that the MTIAC would only be in its initial stage of development provides the opportunity and advantage to gain from previous experience without incurring the drawbacks of converting an existing (previously-developed) large file.

Table 6-5. MTIAC startup strategy.

Planning Element	Near-Term Emphasis
Usage and Users	Initial Limited Access -DOD MT Program Personnel -Defense Contractors -Professional Societies
Information Dissemination	Completed DOD MT Project Results
Technical Scope	Key DOD MT Areas -CAD/CAM -Automated Manufacture/Robotics -Composites Fabrication
Data Bases to Service Inquiries	Bibliographic (via DTIC) Completed, Ongoing, and Planned MT Projects (via DOD system)
Literature Collection	Completed DOD MT Project Reports Journals/Abstracts
Publications	Newsletter DOD MT Journal 2 to 4 State-of-the-Art Reviews Conference Proceedings Special Bibliographies
Conferences/Symposia	2 to 4 Key DOD MT Areas
DOD/MTAG Support	MT Project Results Implementation Analysis
Funding Source	OSD - 10 percent Services - 90 percent
Funding Level	$400K to $700K per year

The MTIAC will essentially be a center which will facilitate the flow of MT information onto the DOD, MTAG, Military Services, and other federal government agencies; to a diverse number of scientific and technical communities; and to private industry. These different levels of users create the need for providing different levels of information handling and dissemination.

The initial task of the MTIAC should be to create a large store of carefully indexed and abstracted items on MT that can be searched and analyzed. This store must then be capable of manipulation in a variety of ways to produce a variety of outputs, each adjusted to the needs of the various user communities. Thus, in the creation of the data base, all the user needs identified in Section 5 must be considered so that the total file is available for whatever purposes it may have to be used.

Initial Priority Activities

ANNOUNCEMENT BULLETIN. One early output of the MTIAC should be an announcement bulletin of current acquisitions for distribution to DOD contractors, related research centers, universities, and industrial organizations concerned with MT information. The bulletin should be arranged by broad subject category and should contain citations with abstracts.

NEWSLETTER. An MTIAC newsletter should be prepared to provide quick, current information dissemination to interested DOD and federal agencies and to private organizations at the discretion of the MTIAC sponsor. It should be prepared by the staff of the MTIAC and be based upon an analysis of the data base, and report on MT news, new MT R&D contracts, MTAG organizational changes, and other significant items of information.

LITERATURE SEARCHES AND SPECIAL BIBLIOGRAPHIES. As the MT user community becomes aware of the MTIAC and grows, there will be more requirements for special bibliographies on all phases of MT research and development, and there will be a substantial increase in requests for specific information. The MTIAC must be geared to answer these questions by providing pertinent references or specific answers to queries. Staffing must be sufficient not only to furnish references, but to select and extract specific information from the selected documents.

MTIAC SUPPORT TO MTAG. A key activity in the initial and future development of the MTIAC will be the continuing support the center will provide to the MTAG and its technical subcommittees. During the startup phase of the center, MTAG and some of its subcommittee members should be contacted to ascertain the exact nature, extent, and requirements for information support that they will want the center to provide.

While it is expected that such support will be minimal, the policy of the MTIAC should be to respond to requests of the MTAG on a priority basis. Among the support the center may be expected to provide on a continuing basis will be technical consultative services and logistics coordination of MTAG conferences.

USE OF ESTABLISHED MEDIA. Most professional societies and other organizations with MT interests produce newsletters and journals of their own. The MTIAC can use these established publications whenever possible to announce center information. The MTIAC should formalize agreements with these organizations and send them specialized announcements and notices to be included in their publications. Or, for example, the MTIAC may contribute an MT column to be published in these media. The center's data base may be manipulated on a standard and recurring basis to print out citations of items which are of special interest to the user communities reached by specific professional publications. An interest profile could be created by the MTIAC for each relevant publication and retained by the system to automatically produce a list of pertinent references for screening and subsequent distribution to the respective publishers. This essentially would be a selective dissemination of information (SDI) system for specific MT user communities using their own professional publications as announcement media.

FUTURE DEVELOPMENT

Planning Perspective

The planning considerations for the intermediate and future development periods listed in Figure 3-4 (see Section 3) provide the basis for organizing a program to react in a meaningful way to the effects of future events with minimum disruption to the MTIAC. By the mid 1980s, the MTIAC may be called upon to play an increasingly active role as the focal point of MT information activities. At that time, the center will be expected to improve and expand its services and prepare special information products for user communities that will be changing in nature and number.

The patterns, trends, and issues of the intermediate and future development periods, as shown in Figure 3-4, will be led and characterized by the new users that will emerge primarily in the private industry user community and, quite possibly, foreign countries. Many developments in MT are being advanced and their results are being published in over 20 countries and a dozen languages. This activity will continue to increase in proportion to the increase of technical advances in these countries and will most likely accelerate under the aegis of American scholarship in the field. Conversely, it is most probable that during this period, the difficult undertakings of acquisition and bibliographic organization of foreign materials may have to be planned.

To provide a perspective and basis for planning the future development of the MTIAC, the following topics will be discussed in terms of their expected impacts on the center during its maturing period:

- Key long-range considerations
- Future cost recovery program
- Future development strategy
- Followup user needs determination.

Key Long-Range Considerations

The most significant considerations for planning the program for long-range development of the MTIAC, as suggested by a review of Figure 3-4 in Section 3, can be classified into three areas: (1) the changes in the MT literature base; (2) user satisfaction with MTIAC services and products and their use patterns; and (3) the trends toward standardization in cooperative services with other information facilities (necessitated by the communication patterns of interactive user networks). Some of the more important trends in these key areas are presented in the following discussions.

FUTURE MT LITERATURE BASE. The literature base for research, teaching, and practice in the MT field will undoubtedly undergo rapid change both in quality and quantity after the MTIAC is operating for a period of time. The center will have concerns in many highly specialized disciplines and researchers will need to draw upon the literature produced in many other disciplines. It is impossible to predict either the rate of such shifts or their precise directions.

Moreover, it is highly probable that by 1990 the continuing rapid pace of scientific and technological research and development will introduce a factor of substantive obsolescence in many kinds of literature retained in the MTIAC collection. Thus, at this time the MTIAC may need to critically evaluate its literature base and reassess the value of its information products.

As regards the diversity in the forms in which future materials will be produced, and accordingly collected and used, it is sufficient in the context of this perspective to mention only a few to indicate the departures from traditional IAC practices that will be necessary. The broad array of audio-visual (A-V) materials will be one area of concern. Microreproductions and publications initially issued in microfilm will proliferate in scientific and technical fields. Motion pictures and still photographs will become essential elements of MT training collections. Video tape cassettes will also start to become a significant part of these collections and may eventually become the most prevalent type of A-V training and MT demonstration tools.

New forms of research materials proliferating as products of electronic data processing (EDP) will most likely present new challenges to the MTIAC by 1990. These materials require radically different treatment from those of traditional library materials. Data banks and computer programs on magnetic tape and other EDP media will increase at a rapid rate as computers become a normal and easily accessible research tool and as software proliferates for microprocessors used in manufacturing.

FUTURE USERS AND USE PATTERNS. Directly linked with the growth of the literature problem is another factor that will require careful attention during this period. It could easily nullify any attempts to improve the accessibility of MT information. This factor is the indifference of scientists and technologists toward the use of information centers and libraries, commonly referred to as "the nonuser problem."

The lack of use of the MTIAC by some researchers and practitioners will undoubtedly compound the MT information problem in that they will not only be flooded with data that lacks good bibliographic control, but they may not even use their own existing facilities to provide some relief. A survey by Auerbach Corporation indicated that information centers and technical libraries are used only 5 percent of the time as first sources of information. The survey claimed that "the technical man is looking for analyzed results, not a lot of midnight reading." They feel that centers and libraries cannot provide this type information because they have not been organized for this purpose.

Such studies have gone so far as to suggest that the design of future information services should be based on the assumption (implied by Mooer's Law) that its users will exert minimal effort to partake of its benefits. In light of these facts, it is recommended that the MTIAC seek to study the patterns of use of its services during this period so as to develop a program to enhance its services to users. A "followup user needs" program is discussed elsewhere in this section.

COOPERATIVE SERVICES AND STANDARDIZATION. To accommodate the steadily increasing MTIAC user population and the concomitant increase in the size of the literature base, the center will have to conduct a continuous promotional program to facilitate the interaction between new users and its collection. A beginning (for the intermediate period) in this area may be for the MTIAC to encourage new users to establish inexpensive, small, private (desk-drawer) libraries of microfiche of special MT areas which they can obtain through an SDI service that may be offered by the MTIAC. However, it is during the long-range development period that the feasibility of improving the user-collections interface by becoming a part of one or more interactive national MT networks should be investigated.

Future Cost Recovery Program

Present USDR&E and DLA operating directives for DOD IAC operations require the establishment of a user charge program, with the objective of generating additional operating revenue equal to 50 percent of the basic funding provided by DOD. This is probably an appropriate objective for an MTIAC operation as well since its expected user community will include DOD, non-DOD government organizations and agencies, industrial societies/associations, individual U.S. firms, and academic institutions.

A study performed in FY75 by the Assistant Secretary of Defense, Director of Interservice Audits, revealed a wide variation of success among DLA-administered IAC operations regarding their individual cost recovery programs. At the time, these centers reported reimburseable funds that ranged from 14 to 57 percent of the funds originally provided by DOD. The average percentage of costs reimbursed for all DLA centers was 39 percent.

A time-phased cost recovery plan should be developed during the center's first or second year of operation. It is anticipated that during its first year, the MTIAC will be supported entirely with military service/USDR&E funds. The IAC financial operating statistics furnished by DLA for the planning study were used in determining how rapidly cost recovery begins to contribute meaningful levels of operating revenues (see Appendix E). The study also considered the appropriate user charges for some typical IAC services and products.

SERVICE CHARGES SYSTEM. A number of currents and pressures enter considerations of support for information services/centers and the role service charges should play. Viewpoints diverge 180 degrees. There is the view that those services/centers providing valuable services will continue since their funding and survival would be a direct function of the customer's willingness to pay. On the other extreme is the view that the federal government or the sponsoring agency has the definite responsibility to facilitate the flow of information to all appropriate users and, therefore, should provide funds for center activities and expansion. Persuasive arguments can be marshalled for each of these views, but individual situations require individual examination. The ensuing are factors to consider.

Information services/centers historically have been funded by a sponsoring organization's research and development program because it has been felt that the following factors are inherent parts of successful research and development: knowledge of prior work on a problem; knowledge of both productive and unproductive findings; knowledge of gaps in information; knowledge of who is working in the field; knowledge of patent constraints; and knowledge of the competitive situation.

Recognition has been given to the view that research and development funds should include the costs of providing systematic input of mission-type information and means for its storage, retrieval, processing, and dissemination. In times when pressures on the research and development budget increase, funds available for information activities decrease. The mechanism of user charges is then introduced or expanded as a way to finance additional services or to make up for reduced revenue or both.

Evaluations should be performed by the center's management during the first year of its operation to determine if the 50-percent cost recovery goal is realistic in light of these problems and the probable time table for achievement of this goal. There are many challenges to establish and maintain an economically administered, realistically priced, and fully auditable service charge system that will be acceptable to users. An important one of these to be considered is the marketing challenge. This relates to identifying and reaching that segment of the center users in a diverse scientific and technical discipline such as MT that will be willing to pay for individual products and services or for packaged offerings on a subscription basis.

Specialized technical libraries in government, private industry, and academia and existing information centers will be possible marketing contact points, although they are somewhat limited since not all such potential users are linked to identifiable libraries or centers. It may also be necessary, particularly in the case of academic users for example, to use broad marketing channels, such as professional journal advertising and broad university and private-firm technical library mailings and, whenever possible, secondary advertising through newsletters to ensure coverage of that user segment. The efficiency of this notification process becomes a significant factor in the cost of marketing the products and services and must be seriously considered in establishing a pricing policy which reflects full cost recovery, at least of the secondary dissemination costs.

Another consideration will be the costs related to "user-orienting" and "tailoring" the center's products and services to maximize their appeal and demand and, thus, easing the task of marketing them. For example, one of the conventional means of cost recovery via user charges used by existing IACs has been the publication and marketing of handbooks and comprehensive data compilations (data books). These types of IAC products require rigorous evaluation of the data before they can be offered and packaged for dissemination to users. In the case of MT data, the tailoring of such products may entail a considerable expenditure of time and cost, due in part to the diverse nature of MT before they can be judged as "technically excellent" and suitable for marketing.

The evaluation to establish the MTIAC service charge system should consider the appropriate user charges for typical IAC services and products, such as the following:

- Technical consultation
- State-of-the-art reviews
- Quick-look or lessons-learned reports
- Technology briefs
- Special literature searches
- Current-awareness newsletters and bibliographies
- Training bulletins
- Technical handbooks and data books
- Technical inquiries or referrals
- Bibliographic inquiries
- Seminars, symposia, and workshops
- Short courses for training/education
- Computer codes, models, and programs
- Video-viewing training tapes.

The product and service offerings assessed to have the greatest potential for success in terms of cost recovery, marketability (market size, packaging, recommended prices, etc.), and user acceptance should be determined from an analysis similar to that outlined in Table 6-6. The selected offerings should then be designed and packaged to meet criteria based upon user data and information needs, data availability, data evaluation requirements, preparation and production requirements and costs, marketing and advertising methods and costs, and pricing considerations. Major factors to be considered in the evaluation of the service charges system are indicated in Table 6-6. At the end of the initial year of MTIAC operation, the center's management should prepare a time-phased implementation plan for a Service Charges System.

FUTURE SERVICES WITH COST RECOVERY POTENTIAL. Among the more promising services that could be offered by the MTIAC and that may have a high potential for cost recovery is an "MT Applications Seminars Program" which could be planned and managed by the center. It is envisioned that two seminars could be offered per year. The MT Application Seminars should be designed to emphasize the practical aspects of MT developments and to familiarize attendees with new applications and advanced manufacturing processes. The seminars program should be structured to complement the other technology transfer activities of the MTIAC, particularly the sale of its publications and technical inquiry services.

Table 6-6. Summary of factors to be considered in the evaluation of a Service Charge System for the MTIAC.

MTIAC Product and Service Offerings	Marketability			MTIAC User Acceptance Rating (scale: 0 to 10)	Cost Recovery	Exemplary Use (by other IACs, etc.)
	Market Size	Packaging	Recommended User Price			
1. Technical Inquiries						
2. Bibliographic Inquiries						
3. Handbooks/Data Books						TEPIAC-Purdue
4. State-of-the-Art Studies						MCIC-Columbus
5. Critical Reviews						
6. Technology Assessments						
7. Current-Awareness Newsletters						MCIC-Columbus
8. Current-Awareness Bibliographies						
9. Special Studies						DASIAC-Santa Barbara
10. Conferences and Symposia						
11. Applications Seminars						MDC-Cincinnati
12. Short Courses and Workshops						UCLA, VPI GE-Schenectady
13. Computer Codes/Models						MDC-Cincinnati
14. Video-Viewing Training Aids						GE-Valley Forge
15. MMC Numeric Data Bank Subscription						GE-Schenectady
16. . . .						

Another promising MTIAC offering that should be considered in the evaluation of service charges will be the preparation, production, and sale of professional training programs via the medium of video tape. Advantages offered by video-viewing for training purposes are:

- Video tapes allow many interested MTIAC users to "be present" at a material/equipment test, demonstration, or other significant event that they could not view in person
- Demonstrations of test and fabrication methods can be recorded for later viewing by a wider audience
- Specific technical problems can be discussed to encourage additional research
- Complex manufacturing processes can be presented for instructing new industrual users
- Potential applications can be illustrated to promote use of new materials and MT in the private sector.

CLASSIFIED DATA CONSIDERATIONS FOR SERVICE CHARGES. Some further discussion is believed appropriate regarding the potential reimbursement the center might receive if some portion of the total data base eventually involves classified data. For any given service charge system, the maximum reimbursement potential will be somewhat impacted if data base and output products of the center are classified. Compliance with provisions of the Industrial Security Manual DOD 5220.22M requires all users to demonstrate appropriate need-to-know based on currently funded DOD contract requirements. This process will quickly divide the potential MTIAC user community into a "cleared" audience and an "uncleared" audience. Classified disseminations must be restricted to the former group, while unclassified disseminations may be distributed to both user groups. The revenue impact can be better understood by discussing a hypothetical special study report which follows:

	Minimum Cost Recovery Objective
Assume: Cost to research and prepare Technology Assessment Report	$20,000
	Minimum Sales Cost
Disseminate as unclassified report to user audience of 500	$40/document
Disseminate as classified report to 100 cleared users	$200/document

While these numbers serve only as examples, it becomes evident that these two reports, equal in research preparation cost and page count, might have to be sold at different price levels depending on the document security classification. The restricted size of the cleared audience may make it difficult to achieve full cost reimbursement on any given classified work task.

MARKET ANALYSIS FOR USER CHARGES. An important task in developing an effective service charge program is to determine the magnitude and needs of the market. A suggested procedure that should be followed by the MTIAC is to run selective searches of the DOD DD 1498 and DD 1673 data banks maintained by DTIC. These searches will quickly identify all contractor organizations and funding agencies for MT programs that may be an important segment of the MTIAC user community. Another valuable source of market information will be a composite list of attendees and participants in recent MTAG and other conferences addressing advanced MT developments and processing or fabrication techniques applicable to defense systems.

The center should also take advantage of the periodic bulletins issued by existing DOD activities to their respective audiences to promote the MTIAC in brief announcements (containing contacts, telephone numbers, and mail addresses) designed to reach a broad cross section of organizations engaged in research, development, test, and evaluation programs for DOD. It is also possible to obtain membership and subscription lists from professional societies and publishers of technical/trade journals. Announcements mailed to this community, however, may be less cost effective, since the percentage of this distribution that reaches potential MTIAC users may be more limited.

CHARACTERIZING THE USERS. After establishing the size of the MTIAC potential user community, it will be necessary to delineate between producers of relevant information and users of relevant information. In the former group, some of these organizations should be considered quid-pro-quo users. It may be more beneficial to the center to provide such organizations with a predetermined level of service free of charge to assure a free and continuous flow of new information and data emanating from their ongoing MT programs. This user group has to be considered the primary source of reimbursement funds, either by direct payment to the center or via document purchase through NTIS.

USER CHARGE SCHEDULE. A firm user charge schedule should be developed and implemented during the second year of MTIAC operation. One of the large uncertainties to be resolved in attempting to forecast potential revenues credited to the MTIAC will be the rate at which the center will move into a classified mode of operation. The eventual prospects of classified operations will directly impact

expected reimbursement to the MTIAC because it will limit the size of the user market. This in turn will sharply reduce the revenues to be realized from sales of products and services of the center.

A review of operations of existing DOD IAC programs with active user charge programs suggests the following types of reimburseable services or products for MTIAC planning purposes:

1. Membership Subscription. This entails a basic fee, often quite modest, by which eligibility is established for the user. The fee often entitles the subscriber to some minimal services as, for example, a periodic newsletter, current-awareness bulletin, or the right to use the reference facilities of the system. The fee may also give the subscriber a discount on the published products of the system or allow him a small set number of inquiries to the system. Subscription charges to external members is higher than to members internal to an organization.

2. Charges for Documents. These may include: periodic bulletins, specialized journals, abstract and index journals, SOARs, compilations, symposium proceedings, monographs, research reports, data sheets, bibliographies, microforms, punched cards, tapes, etc.

3. Charges for Translations. Included items may range from less than a page to monographs of several hundred or more pages.

4. Charges for Reproduction of Documents. Includes microform, dry copy prints, photocopies, punched cards, and tapes.

5. Charges for Responses to Inquiries. Schedules of charges are worked out in accordance with effort involved. Requests for quick response are charged a higher fee.

6. Charges for Symposia, Seminars, and Training Sessions. Attendees are charged fees which cover costs of preparation of subject material, professional and other labor, travel, and published material. A fixed "profit" fee is often built into the charge.

A typical price schedule might be as follows:

Technical inquiry	$10+/inquiry
Bibliographic inquiry	$10/inquiry

State-of-the-art studies	$25 to $50/handbook
Critical reviews/technology assessments	$25/study
Current awareness	$10/search
Education/training seminars	$200/person

A viable option for MTIAC revenue is to offer an annual subscription fee for a package of services. As illustrated below, this could include a combination of services, such as a specified number of prepaid inquiries, a set of quarterly bibliographies, a current-awareness service, and one or more special studies (technology assessments, state-of-the-art reviews, etc.). Handbooks or data books, however, would be separately priced and not included in the annual subscription package.

Subscription service	
Technical inquiries (3)	~$ 40
Bibliographic inquiries (4)	~$ 40
Current-awareness newsletters (4)	~$ 40
State-of-the-art studies (2)	~$ 50
Subscription price	~$200

Early in the second year, the center should determine how much potential visitor traffic may be expected. A set number of prepaid visitor days at the MTIAC may also be included in the annual subscription cost. It should be noted, however, that a "visitor day" is not necessarily equivalent to one visit.

DISADVANTAGES OF USER CHARGES. Relying on revenue from sale of products and services also has hazards. Funding is piecemeal and not guaranteed, resulting in uncertainty of program plans. Charges for products and services reduce the demand for them. Each product and service must be "consumer oriented." Thus, a system's efforts often become diluted, since a significant portion now has to be expended on promotion, selling, billing, and customer relations. Often a greater range of services and products must be provided, with flexibility built in to meet changing requirements. Economic fluctuations in the user community also influence the sales and, therefore, the well being of the system. However, user charges for services are the trend today in DOD and other federal government centers and must be a serious consideration in planning the future development of the center.

Future Development Strategy

FUTURE DEVELOPMENT PLANNING. During the third year of MTIAC operation, it is recommended that the center prepare a development plan

to "grow the center" in a manner consistent with its objectives. Figure 3-4 in Section 3 summarizes the development factors and planning considerations for the "future development period" of the center. This outline should be used as a planning framework to guide the design of the future center configuration. The development plan should be used primarily to summarize the planning information to be included in the required Annual Reports relative to: (1) quantities of products and services to be achieved during the 5-year future period; (2) recommended product and service improvements; (3) limitations and constraints on future development of MTIAC; (4) significant problems encountered or anticipated; and (5) other information worthy of consideration in planning the development of the center.

In addition to the factors listed in Figure 3-4, the center should investigate evolutionary developments that may impact the future MTIAC configuration. For example, one of the more significant of these should be the development of new information and data systems to support the center.

LONG-TERM EMPHASIS. Table 6-7 presents the recommended future development strategy for the MTIAC in terms of a set of planning elements and the center's long-term emphasis. This strategy is structured as a continuation of the phased-development approach discussed previously for the center's startup.

Analysis of the DOD MT program revealed more than 50 broad or generic areas of MT with about two dozen key areas. Future development of the center as indicated in Table 6-7 can be focused on extending its near-term coverage (see Table 6-5) to include ongoing and planned MT projects and all generic and key MT areas, not covered elsewhere, that relate to the DOD MT program goals. This growth should also be designed to accommodate other users, such as nondefense manufacturers, and to provide sophisticated computer-based on-line data exchange with other centers and data bases.

Followup User Needs Determination

After the MTIAC has been operating for a number of years, a sampling of the users originally interviewed should be contacted again by mail or by telephone and their opinions obtained concerning their satisfaction with the center's products and services. The followup mail or telephone survey should also be extended to users other than those originally interviewed. Information concerning the quality and usefulness of the center's products should also be solicited from users during the normal course of their meetings with staff members, their technical inquiries, and other discussions. Contact should also be made with users who are active in the field but have made little or no use of the MTIAC to determine what, if anything, about the center's services is responsible for their low level of usage.

Table 6-7. MTIAC future development strategy.

Planning Elements	Long-Term Emphasis
Coverage	All DOD manufacturing-related technology developments, plus overview of relevant non-DOD federal developments, industrial developments, and international developments.
Users	All DOD staff, other government agencies, defense and nondefense domestic private organizations.
Funding Source	50 percent or less DOD with cost recovery program.
In-Depth Expertise	All areas of MT.
Development and Diffusion Emphasis	Past, ongoing, and planned MT-related developments.
Data Bases	Commercial data base on past, ongoing, and planned MT-related developments; enhanced commercial data base for DOD and MTIAC use; user inquiries; needs; resources; experts.
Publications	Journal; bulletins; newsletters; conference proceedings; special compilations.
Administrative Support to DOD	MTAG meetings, "cost driver" meetings; displays and exhibits, films, video tapes, and presentations.
Technical Support to DOD	Assistance in MT program planning; discretionary funds for implementation and diffusion projects; special studies on MT needs, state-of-the-art, foreign MT developments, etc.
Training	User training courses on nontraditional MT emanating from federal developments.
Conferences and Symposia	All areas of MT development.
Other	Special studies for DOD, other government agencies, and private organizations.

These followup user need responses should then be analyzed for their validity, and appropriate changes should be implemented in the information products, services, practices, or policies of the center.

Among the data that should be sought to determine the improvements in the center's products and services desired by users are:

- Types of Information Needed. The types of information and data needed and sought by the users for their major lines of MT investigations and why sought; changes in information sought as a function of experience with the center and other information services that have become available.
- Current Major Sources of Information. Journals, books, meetings of professional societies, conversations, letters, information exchanges of research results, etc.; best sources and why; extent of use of center as source.
- Current Search Methods. Private property journals and books of the users and of their colleagues; library catalogs; abstracts; information services; DTIC, NTIS, search performed personally or by subordinates; best methods and why; usefulness of center.
- Problems Encountered. Time and cost; information believed or known to exist but unlocated; effects of these difficulties on user's own work; how to decide whether to stop searching; how to decide that enough is known for the immediate purposes; data and publications lag.
- Improvement Suggestions. Users' opinions as to what would constitute a major improvement in information availability; an "ideal" improvement; how each user would personally like to be able to obtain information; opinions about thesaurus approach; thesaurus suggestions, words, the subject information and structure, and thesaurus format.

SECTION 7
MTIAC OPERATIONAL CONSIDERATIONS

Although a DOD-sponsored MTIAC could do much to improve the dissemination and implementation of results emanating from the MT program, the operational effectiveness of such a center will be determined by a number of factors and key concerns that should be given careful consideration during the formative years of the center. The purpose of this section is to briefly discuss such considerations organized under the following categories:

- Operational concerns
- Related national program impacts
- Associated MT issues.

OPERATIONAL CONCERNS

Scope of Technical Coverage

In sponsoring an MTIAC, the DOD must decide whether or not the center will be constrained in terms of the types of MT it will emphasize. If the center is to act as a focal point for information on the DOD MT program, then it should not be constrained. This lack of constraint, however, implies a larger center staff because of the diversity of technology involved and increases the risk of the center expending resources in areas outside of capabilities. Further, some individuals contacted during the study argued that an unconstrained MTIAC may duplicate the efforts of some other IACs. As one IAC director expressed it, "Defining the technical scope of an MTIAC is somewhat akin to measuring the perimeter of an expanding fog."

To assist in determining the breadth of technical coverage appropriate for the center, the following criteria should serve as guidelines for establishing reasonable boundaries:

- Limit coverage to MT for producing or maintaining DOD material
- Include all MT emanating from the DOD/Tri-Services MT programs

- Give primary emphasis to MT required and applied by the U.S. defense industrial base in the manufacture of DOD material.

These guidelines are intended to set limits in terms of where the MT originates, what it is used for, and who is expected to use it.

A methodology to define the MTIAC technical scope should also be devised. The methodology would be most useful if it were based on a scoping structure which relates MT programs with DOD end-products and the technology areas associated with the completed, current, and planned MT projects. Figure 7-1 presents a recommended scoping structure. The intent of the structure is to form the basis for a rationale to justify including technical areas within the scope of an MTIAC's technical coverage. The scoping structure can also be used to identify key technical areas requiring emphasis or priority treatment by an MTIAC.

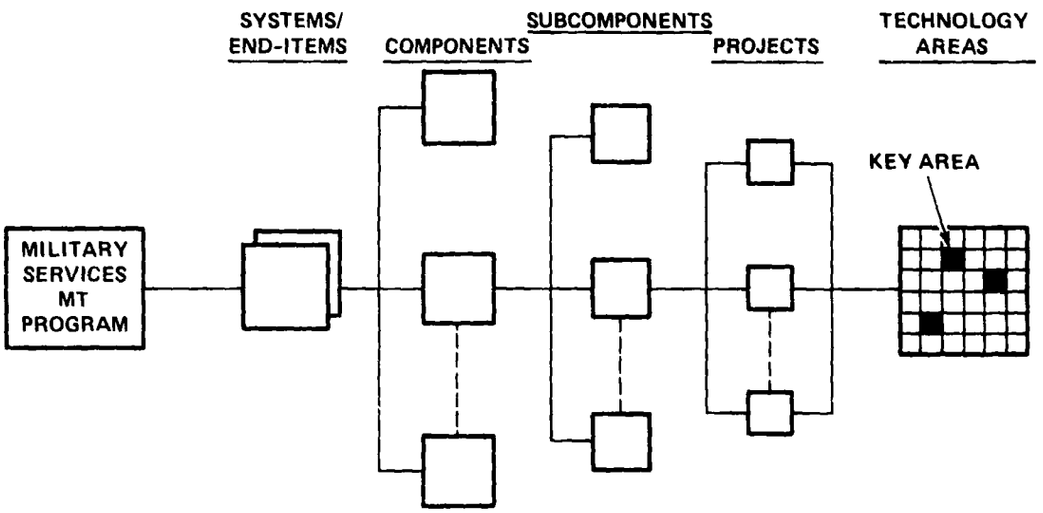

Figure 7-1. Recommended scoping structure for defining MTIAC technical coverage scope.

MT Projects Data Access and Flow

One of the critical problems to be faced in operating an MTIAC will be that of receiving and disseminating timely and accurate information about MT projects. To be of value to its users, the center must have rapid access to past project results and information on the status of ongoing and planned developments. The compilation and analysis of information on past projects results is relatively straightforward and easy to accomplish, while accurate information on

ongoing and planned developments will be much more difficult to obtain. Much of this problem stems from the fact that the Military Services do not have uniform procedures or systems for documenting and managing planned and ongoing projects.

To maintain the accuracy of the information disseminated by an MTIAC, data reporting requirements between the Services and the center will have to be carefully designed, documented, and rigorously controlled. Of particular importance will be information on ongoing projects, since information on these projects should be updated at least monthly. Future DOD efforts to develop a management information system (MIS) for the MT program should be closely coordinated with the operational needs of an MTIAC.

In addition to information flow from the Services to the MTIAC and from the center to nongovernment users, the center could, and should, provide data to DOD. This information flow to DOD and the Services could be in the form of both answers to special inquiries and special on-demand reports. These reports could include annual summaries of projects by agency, defense system, performing organization, technology, scheduled demonstration projects, expected project completions, etc. The DOD should also consider tasking the MTIAC to conduct annual studies of project benefits.

Information Dissemination and Control

As the center matures, it will have to plan and provide the means for including information with restricted access or dissemination as part of its document collection and data base. User benefit requirements for restricted information should be compared at that time with the costs and time involved in the setup and maintenance of control procedures for:

- Personal access to information files
- Electronic/optical access
- Central control versus distributed keys
- National security (classified) information
- Proprietary data
- Export-controlled critical technology.

The cost and time requirements should be investigated for various methods of assuring control not only for the access and dissemination of information, but also for information regrading or reclassifying (upgrade and downgrade).

The center's management should review current practice in existing IACs pertaining to security/proprietary data control and dissemination. Among the items to be reviewed, for example, should be procedures relevant to visits and document distribution.

CLASSIFIED VISITS. Classified information controls are a routine procedure for many IAC operations (such as DASIAC, the DOD Nuclear Information and Analysis Center). In accordance with the Industrial Security Manual, all visitors to such IACs are normally required to file official visit clearances, appropriately certified for need-to-know by the visitor's Contracting Officer's Representative. This may be an authorization for a single visit, or a standing clearance for an extended period consistent with the performance period of the visitor's basic contract. Visitor discussions and the information accessed at such IACs are controlled according to need-to-know and clearance level.

A visit log sheet lists each document or data item (classified or unclassified) provided each individual or group of visitors. This provides a check by which the IAC's staff can verify that all reference items are accounted for at the time of visitor departure.

Classified notes, or copies of selected material from classified documents, are provided to the visitor or are normally mailed to his approved classified mailing address. Copies of complete documents are not usually provided (a current restriction by DOD policy), but a visitor can be given the appropriate AD number for ordering from DTIC if permanent retention is desired.

DOCUMENT DISTRIBUTION. Responsibility for the distribution of all MTIAC publications should normally rest with the center's sponsoring agency. Following the agency's technical approval of all MTIAC final draft documents, the drafts should be returned to MTIAC with an approved distribution list. The final reproduction manuscript plus the approved distribution list should then be forwarded to the agency's printing plant or to DTIC for reproduction and distribution.

On occasion, the MTIAC may be required to generate a classified technical response to an official user inquiry. This distribution could be handled directly by the center. The user should be requested to provide an authorized classified mailing address that is verified by the center by cross reference to the DTIC Dissemination Authority List (DAL) if the user is registered with the DTIC. If this is not the case, the user's mailing address should be verified through the office of the user's contracting officer or the local DCASR office.

Unclassified materials may be disseminated without the above-mentioned controls. However, since some unclassified reports may also have other types of distribution limitations, the sponsoring agency should supply the center with the distribution lists for unclassified documents.

Classified Information Considerations

The percentage of the MTIAC data base that will be classified information is estimated as less than 10 percent. To prevent published documents from inadvertent exposure to uncleared users, a suggested method of control is to flag such files or data items. A considerable degree of dissemination control is provided by appropriately flagging the classified files or data items so that they do not appear in any computer bibliographic listing. Although the volume of classified material retained by an MTIAC will be relatively small, the control procedures that are implemented should be the same as for a relatively large classified information file.

Proprietary/Nonproprietary Data Considerations

Nonproprietary data should pose no unusual operating problems for an MTIAC. However, a task of MTIAC management during its formative period will be to consider how much, if any, proprietary data may be released to the custody of the center and the most cost-effective control procedures required to protect such information.

It should be recognized that certain organizations possessing proprietary information may believe the information presents a business asset of economic value and will refuse to release such information to the MTIAC (i.e., many industrial firms have stringent control of proprietary data). If, however, proprietary data are released to MTIAC, procedures should be implemented making it the responsibility of the originator to clearly advise the MTIAC that, first, the information is proprietary and, second, the limitations he desires are imposed on its access or dissemination. The MTIAC could then key this information in a manner similar to that for classified information and apply similar control procedures (see previous discussion). It is also possible that some organizations may release proprietary information with the stipulation that it is releasable to federal agencies only. Such a requirement, for example, would also have to be accommodated in any "proprietary data control" system developed for the MTIAC.

IR&D Program Data

One particular area that warrants some investigation during the early period of MTIAC operation is the industry IR&D Program. Due to the encouragement from the Military Services to private enterprises, it is anticipated that MT research and development efforts will be increasing, augmenting the advanced research studies traditional to prior IR&D endeavors. MTIAC management should consider the effectiveness of present mechanisms within DOD to identify and monitor the new MT-related IR&D projects. The evaluators of the annual IR&D reports submitted by industry and the on-site DOD IR&D review teams could be directed to forward comments on summaries of pertinent MT

studies to their own Military Service MT Office, the MTAG, and to the MTIAC. This information would then be treated as "proprietary" and released upon request only to authorized DOD offices. If the MT-related IR&D study is evaluated as having particular merit or significance to ongoing DOD procurements, the Military Services may wish to expedite progress on the project with supplemental funding. AMMRC's "Spiderchart" technique could be used to display the relationship of MT-related IR&D projects to the DOD MT goals and technology areas, and to the components, subcomponents, and operations addressed within MT program budget categories.

Export-Limited Critical Technology Information

During the establishment of the MTIAC, its management should address means of coordinating its control keys with current, updated DOD and Department of Commerce foreign technology dissemination regulations and their interpretation or implications. Identifying workable processes that can accurately locate and regrade relevant technology elements will be an important element of this task.

Attention should also be given to those classes of information that fall within the categories subject to U.S. export controls. In a DSB Task Force study conducted by DARPA in 1977, some of the new technology classes that parallel MT subject areas were identified as:

Advanced Material Technologies

- Composites and Composite Structures Technology
- Metals and Alloys Technologies
- Polymers Technologies

Advanced Manufacturing Technologies

- Automation Technology
- High-Rate Sputtering Technology
- Ceramic Processing Technology
- Nondestructive Evaluation
- Automated Test Equipment.

If the MTIAC mission is to serve industrial societies/associations, individual U.S. firms, and academic institutions that may interact with foreign counterparts as a matter of routine, then it appears that all forms of MTIAC outputs may have to be carefully screened.

International Technology Transfer

There has been much concern over international technology transfer because of a growing fear that it entails the export of jobs. In

the late 1950s and 1960s, the United States was an international technological leader; today America's lead has shrunk or disappeared in many industries. As a result, U.S. exports have fallen and imports have increased. There is concern that jobs which should have been created in the United States have instead been created abroad and that U.S. workers have been left unemployed or in less well paid employment. Consequently, government is frequently asked to restrict the export of U.S. technology.

Technology is transferred among countries through many businesses and nonbusiness mechanisms. The nonbusiness mechanisms include patent literature, which is available to foreigners as it is to Americans; university work, such as the training of foreign students; private publications, such as scientific papers, textbooks, and technical documents; conferences, symposia and lectures, for which Americans go abroad and foreigners come to the United States; career development programs under which foreign scientists are brought to work on public or quasi-public research projects; government publications, which contain a wealth of detail regarding new technology; and reverse engineering, an increasingly skilled activity in which products are disassembled in order to determine how they are made.

Important business mechanisms by which technology is transferred include product exports, which frequently involve agreements to provide technical documents and to train foreign personnel in the operation and maintenance of the products; trade shows and exhibits, which provide technical information to participants whether the shows are held here or abroad; licensing, under which foreigners pay for technology, including documents, technical assistance, training, updating, use and maintenance technology, and provision of equipment; direct investment by U.S. firms abroad, which usually entails training foreigners to work on U.S. equipment; joint ventures between U.S. and foreign companies; and turnkey projects in which a U.S. company designs and constructs a large project in a host country and then transfers the project to a company in the host country.

With such an array of mechanisms, it is clear that government or business restrictions on the international transfer of technology would be very difficult to introduce and enforce. Moreover, a comprehensive government program to control international technology movements would pose serious legal, administrative, and economic problems. Furthermore, the United States now has little civilian technology that is not available in other countries.

National security is the one clear justification for controls on technology transfer. It is certainly justifiable for the government to prevent weapons system technology from falling into the hands of potential adversaries. Government controls on technology transfer for national security reasons seem to have worked reasonably well and do not need fundamental change.

As the MTIAC matures, it can be expected to play an important role in monitoring the changes applicable to international technology transfer controls and ascertaining their relevance to the center's operations.

RELATED NATIONAL PROGRAM IMPACTS

Much of the work the DOD MT program is supporting is directly related to areas that other government programs are implementing or exploring on a national level. As these programs evolve, they can be expected to impact objectives and functions of the MTIAC in various ways, particularly in its role as an information transfer agent for MT. The future managers of the MTIAC should be aware of the purposes and needs of such programs and their possible impacts to preclude duplication of activities and to plan services to match or augment their needs. The more significant of the MT-related programs operating on a national level are:

- Department of Commerce, Office of Productivity, Technology, and Innovation (OPTI)
- Cooperative Generic Technology (COGENT) Program
- Center for the Utilization of Federal Technology (CUFT)
- Other Commerce Department MT-Related Programs
- NASA's Industrial Application Centers (IACs).

Office of Productivity, Technology, and Innovation (OPTI)

The Secretary of Commerce has identified the two highest priorities for the Department as international trade and productivity. To pursue these priorities, in February of 1980, the Secretary of Commerce called for the establishment of the Office of Productivity, Technology, and Innovation (OPTI). This change set the organizational structure the Department will utilize to assume a major role in improving U.S. productivity performance.

Headed by the Assistant Secretary of Commerce, OPTI absorbed the Office of Science and Technology that includes the National Bureau of Standards (NBS), the Patent and Trademark Office, and NTIS. Beyond these efforts, however, OPTI has the primary responsibility for implementing the industrial innovation initiatives announced by the President in late 1979.

The goal of OPTI is to increase the competitive position of U.S. industry. Improving productivity is one of the most effective means of achieving that goal. To improve productivity, the major emphasis will be on technology, which many consider to be the most important influence on productivity. The primary target for this emphasis will

be the private sector. The efforts of the Department will not be to supplant private sector efforts, but to play a supportive role in creating a climate to encourage industrial activities.

The strategy to achieve OPTI's goal is threefold:

1. To assist industry in improving productivity through the application of technology, science, and innovation
2. To develop policies and programs to lower the barriers to productivity improvement
3. To assist foreign buyers in purchasing U.S. goods and services.

OPTI's programs are being developed to build in a "demand-pull" element on both of the first two processes. This means that industry input will be sought to establish priorities (demand) for projects in technical development and transfer. To simulate ultimate implementation, OPTI's plans include both efforts to encourage the pace of manufacturing technology development and to improve the transfer of technology.

Cooperative Generic Technology (COGENT) Program

The goals of the Cooperative Generic Technology (COGENT) Program under the Department of Commerce are to stimulate technological and industrial innovation in the United States. In recent years, analysts and decisionmakers in government and industry have noted opportunities for stimulating the development of generic technologies--those that underlie a broad range of industries. These generic technologies, broadly used in industry, are often beyond the capability of any one firm to develop for a variety of reasons (cost, lack of management expertise, and limited return on investment, among others).

To encourage a commitment to technological growth and innovation in these generic fields, the Department of Commerce is promoting cooperative centers for generic technology research, development, and transfer to the private sector. The rationale is that sharing costs, risks, and ideas and building cumulative expertise through such a cooperative program will encourage technical progress in these generic technologies. To this end, the COGENT Program was formed in late 1979.

The COGENT Program establishes nonprofit COGENT centers at universities or other private sector sites. Each center is targeted on a technology that is involved in the processes of several industrial sectors and has the potential for significant technological upgrading.

The activities of a COGENT center are anticipated to include both technology development and transfer efforts. The joint research projects would be complemented by an information clearinghouse, technical services, and educational programs to train management and labor in the application of the technology produced.

Technical areas that are being explored for possible COGENT centers include tribology (the science of friction and wear), computer-integrated manufacture, welding, surface technology, industrial coating composites, and powder metallurgy. Studies seeking broad industry input performed by the staff of the COGENT Program will also support the improvement of international competitiveness. The COGENT Program was planned for fiscal year 1981 with funding at $5.2 million.

Each COGENT center will be responsible for the conduct of major R&D projects in the specified generic technology and for promoting technology transfer and utilization. To carry out this responsibility, each center must perform the following major functions:

- In-House Generic R&D. Each center will conduct R&D to develop the knowledge needed for new technologies which are unlikely to be created without a cooperative effort.
- Technical Services. Each center is expected to design and operate a program of technical services that will provide knowledge of, and ability to utilize, available technologies. The specific nature and mix of these services will undoubtedly vary from field to field.
- Consulting and Technology Service. A center may have the capability to provide consulting and technical services to interested members, and to nonmember firms on an appropriate fee basis. The center must create and distribute a directory of outside experts who can serve as consultants in the specified generic technology.
- Information System Service. Each center may establish and maintain a specialized library and data bank that gathers worldwide information on all new developments relevant to the generic technology and disseminates it to its membership. The center could produce periodic status reports on the technology and respond to queries for technical information from both center members, and from nonmembers on an appropriate fee basis.
- Training. Each center will ensure the availability of programs and facilities for the training

of both management and labor in the evaluation and use of the technology in industry. Such services, if provided in-house, must complement programs available from universities and other sources.

- Technology Evaluation. On a continuing basis, a center will assess new developments in technology on a generic, rather than producer-by-producer, basis. In this way, the center will keep members informed as to the progress being made in the development of the technology and the appropriate utilization of new developments.
- Strategic Planning. The center must have the capability of doing strategic planning in the area of technology development and technology transfer. Strategic planning will involve the periodic assessment of the technology, technology forecasting, identification of critical R&D projects that are required for the advancement of the technology, and of future technology transfer requirements.

Center for the Utilization of Federal Technology (CUFT)

It has recently been recognized that more efforts need to be made both in government laboratories and in government-financed research at universities to transfer nonsensitive technological advances to the private sector and to state and local governments.

The federal government spent nearly $10 billion for research in 1978. The Center for the Utilization of Federal Technology (CUFT) is planned for FY81 to generate a greater and more rapid return for the nation on the investment of federal dollars in R&D. CUFT, to be housed at the NTIS, will seek to increase the utilization by industry of federally developed technical information through intensive marketing including conferences, forums, and special services.

CUFT will assemble and maintain a centralized information system on technology, will act as licensing agent for federal patents, and will promote the interchange of professional staff between federal laboratories and the private sector. CUFT will be the organization to which the industry can turn when seeking information about federally developed technology. One very important element of CUFT will be development of a CUFT Technology Fellowship Program in which representatives of the private sector will be sponsored by their firms to spend equal time in federal laboratories and in the private sector to assess potential yield of federal technology to industry.

Other Commerce Department MT-Related Programs

CORPORATIONS FOR INNOVATION DEVELOPMENT (CIDs) PROGRAM. Through OPTI, the Commerce Department intends to establish two Corporations for Innovation Development (CIDs) in FY81. CIDs will provide direct equity funding for the startup of firms wishing to develop and bring to market a promising, high-risk innovation. CIDs will also provide assistance to potential applicants in obtaining second-round financing and early management assistance to the firms funded.

One CID will be established in an industrial region, the other in a region less industrialized. A revolving load fund provided by the Department of Commerce's Economic Development Administration will be established, with states expected to provide matching funds.

The CID program is being partly modeled after the successful British National Research and Development Corporation and existing state organizations such as the Connecticut Product Development Corporation.

PRODUCTIVITY REFERENCE SERVICE (PRS) PROGRAM. The Productivity Reference Service (PRS) is also planned for FY81 to become the primary source of information in the federal government on the subject of private sector productivity improvement. PRS will provide national and international information on such areas as capital, managerial know-how, and human resources. The PRS will focus on building the productivity information clearinghouse, which will include identifying and describing productivity success stories in the form of case studies and seminars.

FOREIGN TECHNOLOGY UTILIZATION (FTU) PROGRAM. Another initiative aimed at improving the transfer of technology planned for FY81 is the Foreign Technology Utilization (FTU) Program. As part of NTIS, this program will provide better access to foreign developments by collecting, translating, and disseminating selected scientific and technical information produced by other nations.

NASA's Industrial Application Centers (IACs)

The NASA system of technology transfer personnel and facilities extends from coast to coast and provides geographical coverage of the nation's primary industrial concentrations, together with regional coverage of state and local governments engaged in technology transfer activities. NASA programs include:

- NASA Field Center Technology Utilization Officers--manage center participation in regional technology utilization activities

- Regional Remote Sensing Applications Centers--provide training, conduct demonstrations, and offer technical assistance to users of remote sensing data
- Industrial Applications Centers (IACs)--provide information retrieval services and assistance in applying relevant technical information to user's needs
- State Technology Applications Centers (STACs)--provide technology transfer services similar to those of the IACs, but only to state governments and small businesses within the state
- The Computer Software Management and Information Center (COSMIC)--offers government-developed computer programs adaptable to secondary use
- Application Teams--work with public agencies in applying aerospace technology to solution of public sector problems.

Among these programs, the activity most likely to have significant interaction with an MTIAC is the network of Industrial Application Centers (IACs) whose role is to provide information retrieval services and technical assistance to industrial and government clients. The network consists of seven IACS and two STACs affiliated with universities across the country, each serving a geographical area. The centers are backed by off-site representatives in many major cities and by technology coordinators at NASA field centers. The latter seek to match NASA expertise and ongoing research and engineering with client problems and interests.

The network's principal resource is a vast storehouse of accumulated technical knowledge, computerized for ready retrieval. Through the applications centers, clients have access to some 10 million documents, one of the world's largest repositories of technical data. Almost two million of these documents are contained in the NASA data bank, which includes reports covering every field of aerospace-related activity plus the continually updated contents of 15,000 scientific and technical journals.

Intended to prevent wasteful duplication of research already accomplished, the IACs endeavor to broaden and expedite technology transfer by helping industry to find and apply information pertinent to a company's projects or problems. By taking advantage of IAC services, businesses can save time and money, and the nation benefits through increased industrial efficiency and productivity.

Staffed by scientists, engineers, and computer-retrieval specialists, the IACs provide three basic types of services. To an industrial firm contemplating a new research and development program or seeking to solve a problem, they offer "retrospective searches." They probe appropriate data banks for relevant literature and provide abstracts of full-text reports on subjects applicable to the company's needs. IACs also provide "current-awareness" services, tailored periodic reports designed to keep a company's executives or engineers abreast of the latest developments in their fields with a minimal investment of time. Additionally, IAC applications engineers offer highly skilled assistance in applying the information retrieved to the company's best advantage. The IACs charge a nominal fee for their services.

The STACs supplement the IAC system. They facilitate technology transfer to state and local governments, as well as to private industry, by working with existing state mechanisms for providing technical assistance. The STACs perform services similar to those of the IACs, but where the IAC operates on a regional basis, the STAC works within an individual state. In effect, the STAC program focuses on areas not normally served by the IAC, especially in the less industrialized states and among small businesses.

ASSOCIATED MT ISSUES

There are a number of socioeconomic and other issues that are directly relevant to manufacturing that will also have to be considered in planning the scope of interests and concerns of the MTIAC. There are established precedents among the present DLA-administered IACs and other DOD IACs to include such information in the MTIAC. The planning study was concerned with the impact of a number of these issues on the center's scope of coverage. Some of these key associated issues are briefly discussed in the following sections.

Standardization Factors

Standardization in MT could play a substantial role in enhancing the productivity of the defense industries. In planning the MTIAC development, the center's management should examine the role the center could play to promote greater effective standardization in the technology used by the defense industries.

The process of developing standards forces a consideration of all relevant points of view so that any defects in the proposed technology are exposed to criticism and remedial actions. Generally speaking, engineering standards deal with the final product, not with the processes by which it is made. Any steps that can be taken to implement greater standardization in the manufacturing process itself will ultimately promote improved production efficiency.

All differences in products due to nonstandardization impede the DOD's ability to obtain the systems it needs at a minimum cost. Where the differences are real and beneficial, it is to DOD's benefit to promote standardization that encourages wider use of the most advantageous technologies. There may be situations, however, where inferior MTs may be employed simply because of a lack of knowledge of available, standardized ways that are superior. In this case, promotion of the use of the existing standardized techniques is desirable and such promotion could be a valuable task of the MTIAC.

Metrology Factors

Another aspect of standardization--metrology, the science and technology of measurement--also needs to be considered in planning the scope of coverage of the MTIAC. Measurement is essential to the establishment of any form of quantitative knowledge, and quantitative knowledge is essential to the precise control of any kind of MT. Thus, the ability to effectively and inexpensively measure exactly the phenomena that are of importance in employing MT is of vital importance. As a corollary, knowledge of the accuracy of validity of any measurements is similarly necessary. Parts simply will not fit if the measurements to which they are manufactured are not reliable. Similarly, not all kinds of MT will work, or will work only at reduced efficiency, if the measurements used for their control are not reliable. Metrology experts working in industry have noted repeatedly that production line problems "mysteriously" disappear, without anyone knowing for certain their true causes, once steps are taken to enforce accuracy in the measurements used for the control of the relevant MT. The role that the center could play in the area of metrology for the control of MT should be carefully examined during its formative years.

Metrication Factors

Another consideration in planning the center's future development will be the progress toward implementation of the Metric Conversion Act of 1975 (PL 94-168). Planning attention should be given to metric conversion and its impact on DOD weapon procurements. New long-lead-time weapon systems now require metric standards. The need to conform with DOD requirements for interoperability and standardization of equipments destined for joint use by NATO/Allied Forces has placed increasing emphasis on conversion to metric standards. Systems such as ROLAND, HELLFIRE, XM-1 Tank, ASH Helicopter, and Bushmaster Machine Gun are examples of hybrid metric weapons.

Issues related to metrication to be considered by the MTIAC during its formative years include the following:

- Criteria for deciding which new system should be metric

- DOD standards for metric in new design contracts
- Training and implementation programs for metric conversion
- Evaluation of metric experience and problems in U.S. industry.

Requirements for coordination with the American National Metric Council, the Interagency Committee on Metric Policy, and professional societies such as the AEEI, SME, SQC, NCS, and others should also be considered.

Critical Material Substitutes

Consideration should be given to developing an ongoing information file in the MTIAC on frequently used material presently in short supply. Some scarce materials regularly used in production of DOD procurement items have been replaced with alternate raw, or synthetic, materials to ensure continued production. The availability of other materials, while not scarce in terms of worldwide reserves, may be considered strategic or critical because the natural sources of such materials may be controlled by the Soviet Bloc or Third World countries not closely allied with the United States. An example of this is the replacement of platinum cobalt imported from the USSR, previously used in the manufacture of travelling wave tubes (TWTs) for ECM applications, by a domestic material substitute developed by the Air Force MT project. This material substitution reduced costs and lead time, and also improved the performance of the TWT and the ECM capability.

Environmental and Energy Conservation Data

ENVIRONMENTAL DATA. Beyond the physical process of manufacturing, an area of growing concern is the environmental regulatory actions imposed by the federal, state, and local governments. The use of certain types of hazardous materials and toxic liquids in the manufacture of a product, for example, could present severe problems in waste disposal. Contamination of surface and groundwater reservoirs or landfills would involve very costly cleanup and reclamation procedures. Trends in federal regulatory actions that impinge on the U.S. manufacturing community should be monitored by the MTIAC. Advisory notices could be circulated via a newsletter to pertinent DOD-contractor industries to facilitate advanced planning. One DOD IAC (DASIAC) provides environmental assessment support to the DOD, as well as technical services in the nuclear weapons analysis area. This IAC also maintains an Environmental Data Base which, with DOD approval, is registered with the Environmental Protection Agency (EPA) as a source file in the worldwide International Referral System operated by UNESCO.

ENERGY CONSERVATION DATA. Another peripheral MTIAC file of information that should be considered concerns the energy intensiveness and energy conservation attributes of various manufacturing processes and systems and advanced MT developments, particularly those considered for application in the manufacture of DOD weapon systems.

Occupational Safety and Health

Increasingly restrictive OSHA regulations are being promulgated to guarantee worker safety. These regulations focus on many factory type problems such as noise levels, atmospheric pollutants, toxic chemicals and fumes, machine safety guards, and so on. Trends in OSHA regulations should be monitored by the MTIAC and reported in a manner similar to that for environmental information discussed above.

Economic Statistics

It is not clear at this time that cost information will be a useful extension of the MTIAC data base. It should be considered, however, during the early period of establishing the center's data files and document collection. Other IACs have started including such data in their publications. In the Machinability Data Center's (MDC's) Annual Report, for example, information is presented on Machining Costs in the United States. This information includes:

- Approximate annual labor and overhead costs for operating metal cutting machine tools
- Total shipments including exports of metal cutting machinery
- Machine tools accessories industry
- Annual cost of cutting fluids for material removal operations.

Such supplementary economic data outputs may prove to be of considerable value to many future users of the MTIAC.

SECTION 8
REFERENCES

This section provides a selected bibliography of the books, reports, and other documents used for familiarization and other purposes during the planning study, and includes the data compilations and materials supporting the analyses and study results. For convenience of presentation, the section is divided into the following information categories:

- DOD MT Program
- Manufacturing Technology and Productivity
- Information/Technology Transfer
- Information Analysis Centers.

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APPENDIX A

OUTLINE OF USER SURVEY REQUIREMENTS FOR PLANNING THE MTIAC

POTENTIAL USER POPULATION

Specifically, the user population parameter will be concerned with the:

- Number of distinct user communities comprising the user population (e.g., researchers, equipment manufacturers, etc.)
- Estimated size of each user community
- Discipline interest/technical concern of each community
- Geographical distribution of each user community
- Anticipated purposes for which the MTIAC will be used by each user community
- General and special needs of each community in terms of center services and products.

ORGANIZATION/AFFILIATION

From the user survey data, each potential user of the center will be classified, first, according to an organizationally-oriented structure as follows:

- DOD
- Other federal government agencies
- Military departments (Army, Navy, USAF MT program offices)
- Industrial firms
- Professional society or association
- Educational institutions
- Research firms
- General public.

USER PROFILES

Then, user community profiles will be developed in terms of the following categories:

Products or Information Packages Required

Technical Abstract Bulletin	Bibliographies
Title Lists	Data Sheets
Films	Review Articles
Books	Administrative Information
Reports	Accession Lists
Brochures	Popularization
Releases	

Information Services

Public Library	Audio Visual Communications
Research Library	Management Information
Public Relation Type Service	Company Technical Information Center

User Functions

Researcher	Production Engineer
Educator	Student
Layman	Technical Investigator
Administrator/Manager	

Subject/Discipline Interest Areas

Policy and Procedures	Human Factors
Systems and Equipment	Legal and Regulatory

Geographic Location (in Coverage/Concern)

National	State
Regional	Local

INFORMATION SERVICE NEEDS

1. Background Data. Education, career history, major lines of investigation/endeavors over the years, changes in these major efforts.
2. Types of Information. The types of information and data needed and sought by the user for major lines of investigations, and why sought; changes in information sought as a function of experience, libraries, and other information services that become available.
3. Sources of Information. Journals, books, meetings of professional societies, conversations, letters, information exchanges of research results, etc; best sources and why.

4. Search Methods. Private property journals and books of the scientist and of his immediate colleagues; library catalogs; abstracts; GPO; information services; search performed personally or by subordinates; best methods and why.

5. Problems Encountered. Time and cost; information believed or known to exist, but not locatable; effects of these difficulties on own work; how to decide whether to stop searching; how to decide that he knows enough for the immediate purposes; publications lag.

6. Improvement Suggestions. Scientists' and engineers' opinions as to what would constitute a major improvement in information availability; an "ideal" improvement; how each scientist and engineer would personally like to be able to obtain information; opinions about thesaurus approach; suggestions about words for thesaurus, the subject information and structure, and thesaurus format.

FOLLOWUP

After the MTIAC has commenced operation, a sampling of the original interviewees can be contacted again by mail or telephone and their opinions obtained concerning their satisfaction with the center's services. The followup mail or telephone survey could also be extended to users other than those originally interviewed. Contact could also be made with users who are active in the field but have made little or no use of the MTIAC to determine what, if anything, about the center's services is responsible for their low level of usage. These followup responses could then be analyzed for their validity and appropriate changes implemented in the information services, practices, or policies of the center.

QUESTIONNAIRE ON ESTABLISHING A
MANUFACTURING TECHNOLOGY INFORMATION ANALYSIS CENTER
MAY 1980

1. Does a need exist for a central clearinghouse for information on manufacturing technology? Yes No

2. Should such a central facility be chartered as a DoD Manufacturing Technology Information Analysis Center? Yes No

3. (a) Would you characterize yourself (or your organization) primarily as a ____generator, ____ user, ____neither of manufacturing technology (MT) information?

   (b) Would you use a central source of MT information if available to you? Yes No

4. What are your current major sources of MT information among those listed below?

   ___ Journals/Other Periodicals
   ___ Books
   ___ DoD/Government Reports
   ___ Industry Publications/Exhibits
   ___ Handbooks/Databooks
   ___ Newsletters/Bulletins
   ___ Conference Papers
   ___ Seminars/Workshops
   ___ Product Literature/Vendors
   ___ Other_____

5. What data bases and/or information centers (other than the Defense Technical Information Center and National Technical Information Service) do you currently deal with to obtain MT data (include professional society services)?

6. Which of the following problems do you regularly encounter with respect to MT information?

   ___ Unaware of available information
   ___ Needed information unavailable/nonexistent/difficult to locate
   ___ Inconvenient/incomplete form of information
   ___ Poor quality (unreliable, dated, etc.) information
   ___ Information not oriented/slanted to my needs
   ___ Other_____

7. Which of the following products/services would best satisfy your MT information needs (rate items chosen from 1—the most important to 4—the least important)?

   ___ State-of-the-Art Reviews
   ___ Current Awareness Newsletter
   ___ Current Awareness Bibliographies
   ___ Handbooks/Data Books
   ___ Technology Briefs/Notes
   ___ Technical Journal
   ___ Consultants Directory/Referral
   ___ Quick Response to Technical Inquiries
   ___ Conferences/Symposia
   ___ Application Workshops
   ___ Standards/Practices
   ___ Training Materials
   ___ Current Project Status
   ___ Other_____

(Over)

8. Which of the following disciplines would best describe your educational background?

___ Physical/Chemical Sciences
___ Material Sciences
___ Mechanical/Electrical Engr
___ Industrial/Manufacturing Engr
___ Education/Training
___ Environmental/Safety Sciences
___ Information/Library Science
___ Other_____

9. Which of the following areas would best describe your regular work activities or emphasis relevant to manufacturing technology?

___ Research and Development
___ Design
___ Fabrication/Production
___ Test and Inspection
___ Application
___ Demonstration/Training
___ Equipment Evaluation
___ Other_____

10. Which of the following elements of manufacturing would best describe your MT interests and concerns?

___ Materials
___ Machine Tools
___ Automated Manufacture
___ Processes and Methods
___ Machining and Metalworking
___ Computer-Aided Design, Manufacture or Test
___ Special Tools (Dies, Jigs, Molds)
___ Foreign Technology
___ Production Control
___ Inspection and Test Equipment
___ Materials Handling
___ Electronics Fabrication
___ Pollution Abatement
___ Energy Use/Conservation
___ Plant and Facilities
___ Other _____

COMMENTS (e.g., typical question(s) you might ask of an MT information center; MT area of current/greatest interest to you):

Name, Address, Phone _____

_____

_____

_____

RETURN TO: Information Analysis Programs
General Electric–TEMPO
816 State Street
Santa Barbara, CA 93101

T E M P O

CENTER FOR
ADVANCED STUDIES

GENERAL ELECTRIC COMPANY, 816 STATE STREET, P. O. DRAWER QQ
SANTA BARBARA, CALIFORNIA 93102, Phone (805) 965-0551

SAMPLE TRANSMITTAL LETTER
PILOT SURVEY TO GE

General Electric - TEMPO has been awarded Contract No. DAAG46-80-C-0026 by the Army Materials and Mechanics Research Center (AMMRC). The purpose of this six-month study contract is to determine the need and desirability of establishing a DoD Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a Center should undertake. One of the important tasks of the study is to identify the prospective users of the Center and their current sources and needs for manufacturing technology information.

You and your General Electric component have been identified as practicing members of the manufacturing technology (MT) community as evidenced by your current technical interests and concerns. Because of DoD's and General Electric's increasing emphasis on advanced MT and its positive impacts on costs and productivity, a future MTIAC may serve a vital role in technology transfer. Therefore, we shall appreciate your taking a few minutes of your time to complete the enclosed questionnaire. The questions are designed to furnish us with data relevant to your current information problems, sources, and needs and to solicit your candid views concerning the establishment of an MTIAC and its scope. Enclosed are two brief definitions of an IAC and Manufacturing Technology. Please feel free to include additional data or comments if you desire.

Since the time schedule to report the survey results is extremely short, we shall appreciate your returning the completed questionnaire to us as soon as possible and no later than 31 August 1980. A self-addressed envelope is enclosed for your convenience.

AMERICAN DEFENSE PREPAREDNESS ASSOCIATION
DEDICATED TO PEACE WITH SECURITY THROUGH DEFENSE PREPAREDNESS

Founded 1919

SAMPLE TRANSMITTAL LETTER TO INDUSTRIAL FIRMS
FROM ADPA'S "CORPORATE KEY PERSONNEL"
MAILING LIST

The Manufacturing Technology Division of the American Defense Preparedness Association is assisting in a survey of member organizations with manufacturing technology interests and concerns. This survey is an important part of a study contract (No. DAAG46-80-C-0026) awarded to General Electric-TEMPO by the Army Materials and Mechanics Research Center (AMMRC).

The purpose of the study is to determine the need and desirability of establishing a DoD Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a Center should undertake. A major task of the study is to identify the prospective users of the Center and their current sources and needs for manufacturing technology information. The survey is designed to solicit data for making these determinations.

The MT Division of the ADPA has permitted GE-TEMPO to request your cooperation in the survey by taking a few minutes of your time to complete the enclosed questionnaire. The questions are designed to furnish data relevant to your current information problems, sources, and needs and also to solicit your views concerning the establishment of a MTIAC and its scope. Please feel free, however, to include additional data or comments if you desire. Two brief definitions of MT and an IAC are enclosed for your information.

Since the time schedule to report the survey results is extremely short, we shall appreciate your returning the completed questionnaire directly to GE-TEMPO as soon as possible and no later than September 20, 1980. A stamped self-addressed envelope is enclosed for your convenience.

Sincerely,

T E M P O

CENTER FOR
ADVANCED STUDIES

GENERAL ELECTRIC COMPANY, 816 STATE STREET, P. O. DRAWER QQ
SANTA BARBARA, CALIFORNIA 93102, Phone (805) 965-0551

SAMPLE TRANSMITTAL LETTER TO MTAG MEMBERS

General Electric - TEMPO has been awarded Contract No. DAAG46-80-C-0026 by the Army Materials and Mechanics Research Center (AMMRC). The purpose of this study contract is to determine the need and desirability of establishing a DoD Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a Center should undertake. One of the important tasks of the study is to identify the prospective users of the Center and their current sources and needs for manufacturing technology information.

Through your association with the DoD Manufacturing Technology Advisory Group (MTAG), you are in a unique position to assist in making these determinations. Therefore, we shall appreciate your taking a few minutes of your time to answer the questions in the enclosed data sheet. The questions are designed to furnish us with data relevant to your current information problems, sources, and needs and to solicit your views concerning the establishment of an MTIAC and its scope. Please feel free to include additional comments if you desire.

Since the time schedule to report the study results is extremely short, we shall appreciate your returning the completed questionnaire to us as soon as possible and no later than 25 August 1980.

A stamped, self-addressed envelope is enclosed for your convenience.

APPENDIX B

SAMPLE INQUIRY LETTERS FOR EXISTING SYSTEM REVIEW

(a) EXAMPLE OF LETTER SENT TO IACs AND OTHER CENTERS

AND

(b) EXAMPLE OF LETTER SENT TO PROFESSIONAL SOCIETIES, INDUSTRY AND TRADE ASSOCIATIONS, AND ADVISORY ORGANIZATIONS

GENERAL ELECTRIC

T E M P O

GENERAL ELECTRIC COMPANY, 816 STATE STREET, P. O. DRAWER QQ
SANTA BARBARA, CALIFORNIA 93102, Phone (805) 965-0551

24 June 1980

Dr. Richard Smith, Director
Nondestructive Testing Information Analysis Center (NTIAC)
Southwest Research Institute
8500 Culebra Road
P.O. Drawer 28510
San Antonio, Texas 78284

Subject: Man Tech IAC Planning Study

Dear Dr. Smith:

As we discussed during our recent telephone conversation, General Electric - TEMPO* has been awarded Contract No. DAAG46-80-C-0026 by the Army Materials and Mechanics Research Center (AMMRC). The purpose of this study contract is to determine the need and desirability of establishing a DoD Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a Center should undertake. One of the important tasks of the study is to (a) assess the potential for an MTIAC to interface with existing DLA-funded data or information centers to preclude creating duplicating resources, and (b) to analyze the costs, communication mechanisms, and logistics requirements for such interfacing.

The NTIAC has been identified by our AMMRC COTR, Mr. Ray Farrow, as one of the DLA-funded Centers having the potential for interfacing with an MTIAC if it were established. Therefore, we would appreciate your assistance in obtaining some information on NTIAC and also your thoughts and opinions on possible interface between NTIAC and MTIAC.

During our phone conversation I requested some advance data on NTIAC in the form of a charter, latest two annual reports, sample of your brochures and newsletters, and a schedule of user charges. I thank you in advance for your response to that request. I would also be particularly interested in obtaining your views and advice on the following areas which would provide meaningful guidance in our assessment:

1. The need for an MTIAC as a means of technology transfer to the U.S. manufacturing community.

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*A brochure describing TEMPO is enclosed for your information.

2. Your assessment of the scope of an MTIAC in terms of subject coverage activities, and products to be offered so as to preclude duplication/overlaps with the NTIAC.

3. The primary industrial users of NTIAC (i.e., the industries the Center most benefits). Would they also be users of an MTIAC?

4. What is your estimate of the volume of MT information that would be available to an MTIAC from existing sources?

5. How much MT information is already available from existing IACs?

6. Which of the DLA-funded IACs in addition to NTIAC have subject matter coverage and scope similar to that envisioned for an MTIAC?

7. What are the characteristics of the NTIAC that may be common or similar to those of an MTIAC?

8. What products/services/activities of the NTIAC should an MTIAC avoid as duplicative or unnecessary?

9. Which of the other DLA-funded IACs have the greatest potential for interfacing with an MTIAC? In what way? In what subject areas?

10. In your professional judgment, is it feasible to provide an information interface with the NTIAC and these other IACs?

11. Assuming feasible interfacing with the NTIAC, what would be the nature, manner, and form of such interfacing (e.g., computer terminals, director referral, etc.)?

12. What would be the technical and logistics requirements for such interfacing (e.g., response time needs, communication links, etc.)?

13. What existing information services/centers of professional societies and the Military Services would an MTIAC most likely interface with?

14. What are the potential incompatibilities and problems that an MTIAC would encounter in interfacing with the NTIAC?

15. How does the NTIAC acquire, disseminate, and control foreign literature?

I look forward to receiving your responses and thank you once again for your cooperation in the MTIAC Planning Study.

Sincerely,

GENERAL ELECTRIC

T E M P O

GENERAL ELECTRIC COMPANY, 816 STATE STREET, P. O. DRAWER QQ
SANTA BARBARA, CALIFORNIA 93102, Phone (805) 965-0551

9 July 1980

Mr. C. G. Scofield
Forging Industry Association
55 Public Square, Room 1121
Cleveland, OH 44113

Subject: Man Tech IAC Planning Study

Dear Mr. Scofield:

As we discussed during our recent telephone conversation, General Electric - TEMPO has been awarded Contract No. DAAG46-80-C-0026 by the Army Materials and Mechanics Research Center (AMMRC). The purpose of this study contract is to determine the need and desirability of establishing a DoD Manufacturing Technology Information Analysis Center (MTIAC) and to ascertain the scope of activities which such a Center should undertake. Two important tasks of the study are to (a) assess the potential for an MTIAC to interface with existing data bases or information centers and services to preclude creating duplicating resources, and (b) determine the potential sources of information available to an MTIAC, particularly the information resources of professional societies and trade associations with Man Tech interests and concerns.

Your organization has been identified as a professional society with potential for interfacing with an MTIAC if it were established. Therefore, we shall appreciate the opportunity to solicit your views and other data relevant to the above tasks. I am particularly interested in obtaining information concerning the following:

1. Do you maintain a data base or technical literature collection relevant to Manufacturing Technology?

2. If so, is this a data base dedicated exclusively to MT or is it part of a larger data base with broader subject coverage? If the latter, what percentage do you estimate is relevant to manufacturing technology?

3. What is the present size of your literature collection or data base (i.e., number of documents)? What do you anticipate will be its size in five years?

4. Do you publish a journal or other type of periodical covering Man Tech either exclusively or partially? What other types of information products/services do you furnish your membership?

5. Would you be willing to make your MT information (in any form) available to an MTIAC?

6. What would be the nature or form of your interface with an MTIAC?

7. With what other professional societies and trade associations would an MTIAC most likely interface?

Since you or your organization may also be users of an MTIAC, if established, I would appreciate it if you or a member of your staff would take a few minutes to complete the enclosed questionnaire. The questions are designed to furnish us with data relevant to your current information problems, needs, and sources, and to solicit your views concerning the establishment of an MTIAC. Please feel free, however, to include additional comments if you desire.

APPENDIX C

EXISTING SYSTEM COMPONENTS AND POTENTIAL INFORMATION SOURCES

This appendix provides supporting material resulting from the review of existing information resources discussed in Section 4. The appendix is organized in a series of tables to provide a convenient reference tool relevant to the potential information sources for an MTIAC. Each table is designed to correspond to a particular information source category as follows:

Table C-1 -- Existing IACs with MT interests

Table C-2 -- Professional societies, industry and trade associations, and advisory organizations with MT interests

Table C-3 -- Existing military service data bases with MT interests and concerns

Table C-4 -- Other federal data bases identified as potential sources of MT information

Table C-5 -- Representative sample of private MT-related data bases

Table C-6 -- Professional societies and trade organizations with potential for interfacing with an MTIAC.

Table C-1. Existing IACs with MT interests.

Center	Contact
Alloys Data Center (ADC)[a]	Dr. Lawrence H. Bennett Director
Chemical Propulsion Information Agency (CPIA)	Mr. Ronald D. Brown Director
Infrared Information and Analysis Center (IRIA)	Ms. Mildred Benecke Service Point of Contact
Machinability Data Center (MDC)[b]	Dr. John Kahles Director
Mechanical Properties Data Center (MPDC)	Mr. Harold Mindlin Director
Metals and Ceramics Information Center (MCIC)	Mr. Harold Mindlin Director
Nondestructive Testing Information Analysis Center (NTIAC)	Dr. Richard Smith Director
Plastics Technical Evaluation Center (PLASTEC)[a]	Mr. Harry Pebly Director
Reliability Analysis Center (RAC)	Dr. Charles Ehrenfried Director
Shock and Vibration Information Center (SVIC)[a]	Mr. Henry Pusey Director
Tactical Weapon Guidance and Control Information Analysis Center (GAGIAC)	Mr. Charles Smoots Director
Thermophysical and Electronic Properties Information Analysis Center (TEPIAC)	Mr. Wade H. Shafer Assistant Director

[a]Not DLA-funded.

[b]As of FY 81, MDC will be run on a private basis by Metcut Research Associates, Inc. (its previous manager under DLA sponsorship) with no government funding.

Table C-2. Professional societies, industry and trade associations, and advisory organizations with MT interests.

Organization	Contact
Advisory Group on Electronic Devices	Mr. David Slater[a]
Aerospace Industries Association	Mr. Walter Weitner[b] Director, Aerospace Operations Service
American Defense Preparedness Association (ADPA)	Col. Rudy Rose[b] U.S. Army (Retired)
American Foundrymen's Society (AFS)	Mr. Ashley Sinnett Executive Vice President
American Institute of Chemical Engineers (AIChE)	Mr. Ken Wood[b]
American Institute of Industrial Engineers (AIIE)	Mr. Mikell Grover[a]
American Institute of Industrial Engineers (AIIE)	Mr. J.F. Wolbrink Managing Director, Education and Publications
American Production and Inventory Control Society (APICS)	Mr. Henry F. Sander Executive Director
American Society for Metals (ASM)	H. David Chafe Director, Metals Information
American Society for Testing and Materials (ASTM)	Mr. Thomas Gregory[b]
American Society for Testing and Materials (ASTM)	Ms. Betty J. Preston[a] Assistant to Deputy Managing Director
American Society of Mechanical Engineers (ASME)	Ms. Ellen Lanman Director of Technical Programs
American Welding Society (AWS)	Mr. Moss Z. Davis Manager, Technical Operation
Cast Metals Federation	Mr. William Gephardt, Jr.[b]

(continued)

Table C-2. (Continued).

Organization	Contact
Electronic Industries Association (EIA)	Mr. Jean Caffiaux[b]
Federation of Materials Societies (FMS)	Mr. Bernard Sallot Executive Director
Forging Industry Association	Mr. C.G. Scofield[b]
Industrial Association of Production Engineers	Mr. William Kahn Executive Vice President
Institute of Electrical and and Electronics Engineers (IEEE)	Mr. John Powers President, Components, Hybrids, and Manufacturing Technology
Institute of Electrical and and Electronics Engineers (IEEE)	Mr. Elwood Gannett Director of Publications
Manufacturers Standardization Society (MSS) of the Value and Fittings Industry	Mr. Robert V. Warrick Executive Secretary
National Association of Manufacturers (NAM)	Mr. Brendan Sommerville Director of Science and Technology
Numerical Control Society	Mr. John C. Williams[b]
Society of Manufacturing Engineers (SME)	Dr. Richard Kegg[b]
Society of Manufacturing Engineers (SME)	Mr. Bernard Sallot Professional and Governmental Activities Division
Society of Manufacturing Engineers (SME)	Dr. William Spurgeon[b]
Welding Research Council (WRC)	Mr. Kenneth H. Koopman Executive Director

[a]MTAG Executive Committee or Technical Subcommittee member (or designated representative), 1979.

[b]MTAG Executive Committee or Technical Subcommittee member, 1980.

Table C-3. Existing military service data bases with MT interests and concerns.

Aerospace Structures Information and Analysis Center (ASIAC)
Wright-Patterson AFB, Ohio

Air Force Wright Aeronautical Laboratories
Wright-Patterson AFB, Ohio

Army Armament Material Readiness Command
Technical Library
Rock Island, Illinois

Army Armament Research and Development Command
Scientific and Technical Information Division
Dover, New Jersey

Army Communications and Electronics Material Readiness Command
Scientific/Technical Information
Management Information Systems Directorate
Ft. Monmouth, New Jersey

Army Electronics Research and Development Command
Technical Support Activity
Technical Library Division
Ft. Monmouth, New Jersey

Army Electronics Technology and Devices Laboratory
Ft. Monmouth, New Jersey

Army Materials and Mechanics Research Center (AMMRC)
Technical Library
Watertown, Massachusetts

Army Materiel Development and Readiness Command (AMDRC)
Technical Library
Alexandria, Virginia

(continued)

Table C-3. (Continued).

Army Materiel Development and Readiness Command (AMDRC)
Technical Industrial Liaison Office
Alexandria, Virginia

Army Materiel Development and Readiness Command (AMDRC)
Inernational Training Center
Texarkana, Texas

Army MT Management Information System
Army Industrial Base Engineering Activity
Rock Island, Illinois

Army Research and Development Command
Benet Weapons Laboratory
Technical Library
Watervliet Arsenal
Watervliet, New York

Army Tank-Automotive Research and Development Command
Technical Information Office
Warren, Michigan

Naval Research Laboratory
Technical Information Division
Washington, D.C.

Naval Surface Weapons Center
White Oak Laboratory
Silver Spring, Maryland

Naval Weapons Center
Technical Information Center
China Lake, California

Source: Defense Documentation Center Referral Data Bank Directory, DDC/TR-78/2, AD-A055 700, June 1978.

Table C-4. Other federal data bases identified as potential sources of MT information.

Computer Software Management and Information Center (COSMIC)
University of Georgia
Athens, Georgia

Diffusion in Metals Data Center
Metal Science and Standards Division
Center for Materials Science
National Bureau of Standards (NBS)
Washington, D.C.

Government-Industry Data Exchange Program
GIDEP Operations Center
Corona, California

Harry Diamond Laboratories (HDL)
Scientific and Technical Information Office
Adelphi, Maryland

Institute for Computer Science and Technology
National Bureau of Standards (NBS)
Washington, D.C.

National Referral Center
Science and Technology Division
Library of Congress
Washington, D.C.

NBS Standards Information Service
Standards Application and Analysis Division
National Bureau of Standards (NBS)
Washington, D.C.

Technology Application Center (TAC)
University of New Mexico
Albuquerque, New Mexico

Sources:
1. Defense Documentation Center Referral Data Bank Directory, DDC/TR-78/2, AD-A055 700, June 1978.
2. Directory of Federally Supported Information Analysis Centers, National Referral Center, Library of Congress, 1979.

Table C-5. Representative sample of private MT-related data bases.

Data Base	Subject Coverage	Holdings
Armstrong Cork Company Management Reference Service Lancaster, Pennsylvania	Manufacturing methods, manufacturing processes.	1820 books; pamphlets; archival materials; 346 journals and serials.
CAM-I International (CAM-I) Library Arlington, Texas	CAD, CAM, numerical control, automatically-programmed tools, process planning.	2000 books.
Cincinnati Milacron Corporate Information Center Cincinnati, Ohio	Machine tools, metalworking, polymer chemistry, automated manufacturing.	5000 books; 4000 bound periodicals; 200 other cataloged items; 200 journals and serials; Lockheed, SDC, Union List of Serials.
Clark Equipment Research and Development Center Buchanan, Indiana	Manufacturing technology, mechanical engineering, welding, metallurgy, nonmetallic materials, electronics; special collection on fracture mechanics.	1100 books; 500 technical reports; 130 journals and serials.
General Electric Company Main Library Schenectady, New York	Engineering, manufacturing, management, metallurgy, sciences, business.	15,000 books; 15,000 bound periodicals; 43,000 pamphlets, translations, NASA reports and other documents; 20,000 NASA, other documents, and translations on microfiche; 650 journals and serials.
Norland Corporation Norland Associates Technical Library Fort Atkinson, Wisconsin	Product engineering, materials for design, manufacturing modes, mechanical design, electrical design.	300 books; 4000 supplier catalogs; unbound technical data, safety standards, 20 journals and serials.

Source: Directory of Special Libraries and Information Centers, 5th edition, Margaret L. and Harold C. Young, Gale Research Co., Detroit, Michigan, 1979.

Table C-6. Professional societies and trade organizations with potential for interfacing with an MTIAC.

Organization	Comments
American Foundrymen's Society (AFS)	Definitive source for information on production of castings. Has 50- to 60,000 documents and adds about 1000 per year. Has document retrieval system. Publishes Modern Casting (monthly), International Cast Metals Journal (quarterly), handbooks, technical reports, research reports, and transactions. Provides education through the Cast Metals Institute. Is an information center and makes referrals.
American Institute of Industrial Engineers (AIIE)	Maintains library of books, technical reports, and other materials on industrial engineering, including MT (about 20 percent). Publishes Industrial Engineering (monthly), The Engineering Economist (quarterly), IER&D transactions (quarterly), and special studies and reports.
American Production and Inventory Control Society (APICS)	Maintains technical literature collection of several hundred documents related to MT. Publishes APICS News (monthly), Production and Inventory Management (quarterly), APICS bibliography, dictionary, and training manuals.
American Society for Metals (ASM)	In conjunction with The Metals Society (U.K.), collects and disseminates information on all aspects of metals and related materials. Produces Metadex data base as counterpart of Metals Abstracts which includes significant amount of coverage of MT technical literature and is available directly on-line. Also publishes Metal Progress (monthly), Metallurgical Transactions (monthly and quarterly), handbooks, and over 60 texts on metals. Frequently cited source of MT information in TEMPO user survey. Interested in interfacing with MTIAC.
American Society for Testing and Materials (ASTM)	Feels that MTIAC could possibly be helpful to ASTM committees in their standards development activities.

(continued)

Table C-6. (Continued).

Organization	Comments
American Society of Mechanical Engineers (ASME)	Frequently cited source of MT information in TEMPO user survey. Maintains, with other engineering societies, a 180,000-volume library. Publishes Mechanical Engineering (monthly), Applied Mechanics Review (monthly), and transactions journals on 10 topics (quarterly).
American Welding Society (AWS)	Answers technical inquiries. Publishes Welding Journal (monthly), Welding Handbook, and over 100 technical publications. Primary information source is Weldasearch data base accessed through Lockheed's DIALOG system.
Electronic Industries Association (EIA)	Provides for technological exchange within the industry by holding symposia, technical meetings, and workshops.
Institute of Electrical and Electronics Engineers (IEEE)	Has 30 groups (e.g., Components, Hybrids, and Manufacturing Technology), each of which publishes its own journal and holds its own meetings. Indexes all of its own publications including conference papers and proceedings, journal articles, transactions, and books. Has its own press. Frequently cited source of MT information in TEMPO user survey.
Society of Manufacturing Engineers (SME)	Most frequently cited professional society source of MT information in TEMPO user survey. Has in-house data base, indexed since 1974, of technical reports and papers of the Society and articles from its monthly Manufacturing Engineering. Has technical literature collection of 12,000 books, papers, and reports and 200 periodical subscriptions. Also publishes Robotics Today (quarterly) and about 400 papers, handbooks, and specialized technical volumes. Sponsors about 25 trade shows and 150 conferences and special programs.
Welding Research Council (WRC)	Has large literature collection on welding. Established to conduct needed cooperative research in welding and allied fields, to disseminate research information, and to promote welding research in universities. Considered the welding research arm of eight engineering societies and six trade associations. Acts in advisory capacity to aerospace and other industries.

APPENDIX D

SIGNIFICANT COMMENTS FROM PROSPECTIVE USERS SURVEY RESPONDENTS

This appendix presents comments that are representative of those received from potential MTIAC users as documented in their completed survey questionnaires and interview notes. Only those comments considered to be of some significance to the MTIAC planning study are included. The comments are divided into the following general categories:

- Positive Comments Concerning an MTIAC
- Information Needs and Desired Products/Services
- Sample Technical Inquiries From Potential Users
- Negative Reactions to Establishing an MTIAC.

POSITIVE COMMENTS CONCERNING AN MTIAC

SOURCE	COMMENT
DOD Contractors	• The use of IACs cannot be said to save work, money, time, or staff because we use them for services which, were they not available from outside sources, would not be performed at all. Since we do not, in many cases, qualify for free service, the use of an MTIAC will increase our money expenditures. I am, however, reasonably sure that our return on (information) investment is greater using the IACs than it would be were we to attempt the function in-house. The cost necessary to provide the staff, facilities, and resources would far exceed the service charges.
	• An MTIAC may help us give more individualized assistance to our scientists and engineers. Individual interests are so diversified here that we could not provide as selective a service without IACs. Those that provide consulting service are especially useful to the scientists. Our men contact MCIC and EPIC directly.

SOURCE	COMMENT
DOD Contractors (continued)	• We have used MCIC for specific reports. Our phone calls and letters have been handled most graciously and expeditiously. The center was just another one of the sources of information we contacted to get a piece of information. The beauty of an MTIAC is that it isn't tied up in the time-consuming bureaucracy of the DTIC, which apparently cannot cope with the immediacy of need we face in requests in industrial libraries such as ours. • We see the need for an MTIAC because it will: 1. Save time and probably money with a limited staff for on-location searching 2. Make our literature search more comprehensive, therefore more effective 3. Identify unpublished materials in current and timely use 4. Identify the status of ongoing MT research of company interest 5. Serve as an adjunct to other sources of material which are available elsewhere.
Non-DOD Industry	• The expectancy for the future is that our technical library will grow to keep pace with industry competition and the proliferation of information. An MTIAC is regarded by this writer as a supplementary tool which may become more valuable as a function of time. • An MTIAC can provide additional services which we do not have the staff or time to provide. Because it will be specialized in MT, it can provide information which our broad range of subject interests does not allow us to maintain in our own collection; we can therefore put greater emphasis on our major MT subjects when we are not so concerned with collecting a "smattering" of everything. If better utilized, our consultation with experts at an MTIAC should improve the quality and timeliness of information. • I do not feel that use of centers such as an MTIAC presents any savings to our technical library per se. However, there are many benefits to the Company which would be very difficult to evaluate or

SOURCE	COMMENT
Non-DOD Industry (continued)	calculate. Therefore, it is our position to take advantage of all available services provided by the IACs and I encourage their use whenever required.
MTAG Subcommittee	Our reasons for establishing an MTIAC are: 1. To obtain immediate response to inquiries on MT projects 2. To identify similar or duplicative efforts 3. To establish reliable points of contact 4. To obtain concise objective for MT projects 5. To identify problems earlier in the cycle.

INFORMATION NEEDS AND DESIRED PRODUCTS/SERVICES

SOURCE	COMMENT
DOD Contractors	• In the past, I have attempted to obtain data on projects that were funded (i.e., interim progress reports, final reports, and even the schedule for contractor's demonstration of completed projects). Results were poor or very limited. • In working to formulate a new MT program: 1. Who, if anyone, has been funded to do specific work or similar work? 2. Government experts, consultant experts in specific area? 3. Anyone doing feasibility work on this work-direct contract or IRAD? 4. Has this been developed under a system project funded by the government? • An MTIAC might result in an umbrella organization directing searcher to MDC, Batelle, etc. as appropriate. Cost data may be difficult to get and/or handle realistically and properly, i.e., what are the cost drivers for making a particular or generic type part? What are the nonrecurring and recurring costs involved in implementing a particular ManTech development? If I can't learn this, the best technical information available will still not result in cost reductions.

SOURCE	COMMENT
DOD Contractors (continued)	• Have a comprehensive cross reference index associated with binary and tertiary alloys like tin-lead solder and tin-lead-silver solder.
	• Supply a comprehensive foreign production equipment listing comparable to Thomas Register for different kinds of production equipment used in electronics manufacturing.
MTAG	• Lack of availability of MT data in a format which can be readily applied by a new party. Lack of detail to avoid duplication of effort.
	• Find out what MT people in DOD and military are doing concerning MT programs so we don't reinvent the wheel.
	• MT information as it presently exists for the three services requires a massive effort to assemble with any assurance of completeness and further effort to condense it to an assimilable volume.
	• I need to know what MT projects are completed, current, and planned; the lead activity; and project manager. We need a central source to compile this data for the Tri-Services.

SAMPLE TECHNICAL INQUIRIES FROM POTENTIAL USERS

SOURCE	COMMENT
DOD Contractors	What improvements are there in manufacturing processes, techniques, materials, or equipment from the standpoint of reliability improvement?
	Can I obtain more detailed feasibility studies, since the concurrent applied research seems necessary for some of the programs sponsored by DOD?
	What commercially available management systems are available that support government requirements?
	What KNC software/hardware systems are available to support electronics manufacturing?
	Where does equipment (specific) capability exist among government contractors?

SOURCE	COMMENT
DOD Contractors (continued)	Can you help me locate applications of CMM (Coordinate Measuring Machines) interfaced, on-line to CAD systems?
	Can you help me locate factory test systems tied into "DNC Line" networks with possible further ties to overall Quality Information System?
	What are the applications of CAPP (Computer Aided Process Planning) to assembly and/or test and inspection areas?
	Who has advanced automatic manufacturing (e.g., robotics) facilities?
	What companies (in the United States) are now manufacturing advanced machine tools?
	Can you furnish alternate processes and methods to do a job to improve product quality, reduce costs (e.g., equipment availability, vendor information, suitability to our needs)?
	I would like some information on related environmental concerns such as worker's safety, pollution potential of advanced manufacturing processes in composites.
	One area that I find lacking in the industry is information on the effects of various manufacturing processes on long-term reliability.
	I would like the names of vendors with good software programs to use with CADMAT.
	Who in the United States has sophisticated automatic manufacturing facilities that produce over 2 million printed circuit boards per year? What equipment do they use?
	What kind of high productivity equipment is being used for material handling in a large U.S. electronics manufacturing plant?
	What are the cost justification factors in converting a manual electronics manufacturing plant to an automatic one?

SOURCE	COMMENT
DOD Contractors (continued)	Please furnish state of the art of microprocessors in small parts fabrication, including foreign technology.
	What are the latest developments in plasma etching of polymers to improve adhesion?
	Do you have current information on hybrid circuit technology state of the art?
	Latest technology to process engineering design into discrete hardware fabrication for precision microwave printed circuit boards.
	What is your estimate on the timing of the introduction of "seeing" robots in small parts assembly?
	What progress has been made on real-time tool wear monitoring?
	Please furnish data on foreign printed wire-board fabrication and assembly.
	Will you send me information on state of the art in aircraft bearing manufacturing: specifically, rolling element bearings, dry bearings, grinding methods, advances in metrology, feasibility of ceramic bearings, tooling for composite dry bearings, powder met bearing processing?
	What are commonly used printed circuit board fabrication processes? Which ones produce the least pollution?
	What kind of a test yield can be expected from a printed circuit board with 200 integrated circuits?
	What kind of integrated circuit failure rates are being experienced in industry, domestic and foreign?
	List the physical and chemical properties of manufacturing materials associated with printed wiring boards, hybrid circuits, potting, encapsulation, and conformal coating.

NEGATIVE REACTIONS TO ESTABLISHING AN MTIAC

SOURCE	COMMENT
DOD Contractor	As manager of our Company's library for almost 15 years, I believe that the overall services and functions of IACs such as your proposed MTIAC are limited, at best. The major problems which I have noticed are: 1. Time from request to completion: on the average, poor to fair. 2. The report bibliographical services of DTIC and NASA are infinitely superior to my customers (several thousand scientists and engineers). 3. In several cases, cost charges are prohibitive. CPIA, for example, has billed us for $800.00 for the minimal services which they offer. I am able to get most of these from NASA and DTIC for less.
Non-DOD Industry	• I'm not sure an MTIAC should be DOD chartered. Many commercial departments (in industrial firms) tend to shy away from defense-oriented sources of information. • There appears to be sufficient material available in the industry marketplace and in technical journals; should not be a need for an additional "government involvement" in MT information activities. • MT information presently covered adequately by MTAG, journals, DTIC, NTIS. • It may be that the technology centers to be established by the Department of Commerce in the COGENT Program may well serve the same purpose as an MTIAC. • There is a proliferation of "information centers" all competing for money and few, if any, providing a useful service. Let's stop wasting resources in this area and apply ourselves to more productivity areas. • Most of our personnel use some of the centers listed. This plant <u>is</u> a government contractor, but none of the centers used is one whereby one actually needs to receive its services. We don't foresee heavy use of an MTIAC.

SOURCE	COMMENT
Non-DOD Industry (continued)	• "Upon request" services have proved unsatisfactory. Most of the centers such as an MTIAC are just data retrieval centers. Unless you tell them exactly what sources of information you already have (and specifically bar this information), most of the data received duplicates that in a good technical report collection. • Most IACs hinder in their efforts to justify their existence by their continual drum-beating advertisements. One gets tired of throwing the twelfth or twenty-fifth blurb in the waste basket. Their literature searches, current-awareness services to individuals, and bibliographical compilations, however, relieve my library of a number of time-consuming searches. • Communicating with IACs is very difficult over the phone. If one can take the time to put his wants on paper, he can just as well use this time and dig up the information himself. Usually it will be of equal quality and thoroughness. How can an MTIAC improve on this? • An MTIAC would be another government agency doing what the private sector is already doing.
MTAG Subcommittee	Need exists for an MTIAC, but a system developed at IBEA is already in existence, easily augmented to cover DOD needs.
Technical University	We use IACs to supplement our services and feel that they actually add to functions of acquisition, processing, filing, indexing, etc., rather than reduce them. They generate work rather than save work. This also applies to an MTIAC.
Government Research Laboratory	Information should be available from the IACs, such as an MTIAC, earlier than we would normally receive it through other channels. However, we have not seen much of this recently. The greater amount of information received duplicates information already in-house.

SOURCE	COMMENT
University Research Center	• I would rather have the federal government beef up the services from DTIC, NASA, AEC, NTIS, etc. and do away with many (not all) of the IACs where disciplines and reports are duplicate work effort. • DMIC, which did not charge, was most used and offered the best service. PLASTEC would have been used but their charges are outrageous. MPIC would have been used more but their charges are also high. If an MTIAC has user charges, we will not use it.

APPENDIX E

IACs SERVICE AND FUNDING LEVELS SUPPORT DATA

A summary of the cost and other data used to derive the recommended service and funding levels for an MTIAC, based upon a comparative evaluation of other IACs for fiscal years 1975 and 1979, is contained in Table E-1. This summary is intended to provide baseline data of direct and reimburseable funding levels and the staff size corresponding to the levels.

Table E-1. Summary of IAC personnel strength and funding data.

DOD Component/Information Analysis Center	Number of Personnel	Type of Operation	FY 1975 Funding		Total Percent of Operating Costs Reimbursed	FY 1979 Funding[a]		
			Direct	Reimburseable		Direct	Reimburseable	Total
DEFENSE SUPPLY AGENCY								
Chemical Propulsion Information Agency	22	Contract	$ 323,000	$ 435,000	57	$385,000	$465,000	$ 850,000
Thermophysical and Electronic Properties Information Analysis Center	17	Contract	312,000	50,000	14	485,000	67,000	552,000
Infrared Information Analysis Center	10	Contract	212,000	210,000	50	393,000	402,000	795,000
Machinability Data Center	5	Contract	180,000	158,000	47	162,000	270,000	432,000
Mechanical Properties Data Center	8	Contract	139,000	130,000	48	210,000	62,000	272,000
Metals and Ceramics Information Center	21	Contract	791,000	325,000	29	784,000	600,000	1,384,000
Nondestructive Testing Data Support Center	9	Contract	291,000	125,000	30	300,000	78,000	378,000
Reliability Analysis Center	21	Contract	474,000	301,000	39	420,000	780,000	1,200,000
Subtotal	113		2,722,000	1,734,000	39			
DEPARTMENT OF THE ARMY								
Plastics Technical Evaluation Center	11	In-House	240,000	365,000	60			
Concrete Technology Information Analysis Center	2	In-House	50,000	0	0[b]			
Soil Mechanics Information Analysis Center	2	In-House	50,000	0	0[b]			
Pavements and Soils Trafficability Information Analysis Center	2	In-House	50,000	0	0[b]			
Hydraulic Engineering Information Analysis Center	2	In-House	50,000	0	0[b]			
Cold Regions Science and Technology Information Center	4	In-House	50,000	0	0[b]			
Coastal Engineering Information Analysis Center	3	In-House	20,000	0	0[b]			
Chemical Information Data System	4	In-House	127,000	0	0[b]			
Nondestructive Testing Information Analysis Center	3	In-House	50,000	0	0[b]			
Subtotal	33		687,000	365,000	35			
DEPARTMENT OF THE AIR FORCE								
Aerospace Structures Information Analysis Center	4	Contract	77,000	80,000	51[c]			
Nonnuclear Munitions Information Analysis Center	4	Contract	70,000	50,000	42[c]			
Subtotal	8		147,000	130,000	47			
DEPARTMENT OF THE NAVY								
Shock and Vibration Information Center	6	Contract/ In-House	220,000	192,000	47			
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY								
Tactical Technology Center	6	Contract	100,000	0	0[b]			
DEFENSE NUCLEAR AGENCY								
Defense Atomic Support Information Analysis Center	25	Contract	997,000	0	0[b]			
TOTAL	191		$4,873,000	$2,421,000	33			

Source: Report on the Review of the DOD Information Analysis Centers, DTIC, Alexandria, Virginia.

[a]DLA-furnished data as of August 1980.

[b]These centers had not implemented the DOD user charge program.

[c]These centers had only partially implemented the DOD user charge program.